VOLUME XXXIII NUMBER FIVE

THE NATIONAL GEOGRAPHIC MAGAZINE

MAY, 1918

CONTENTS

National Geographic Society Map of the Western Theatre of War

Presenting a Complete and Authoritative Survey of All Places, Forests, and River Systems Figuring in the Press Dispatches from Western Front

Size, 27 x 31¼ Inches; Scale, 7¼ Miles to Inch

Smaller North American Mammals

32 Pages in Full Colors

EDWARD W. NELSON—LOUIS AGASSIZ FUERTES

An Intimate Study of the Smaller Wild Animals of North America by the Foremost Authorities

PUBLISHED BY THE
NATIONAL GEOGRAPHIC SOCIETY
HUBBARD MEMORIAL HALL
WASHINGTON, D.C.

$2.50 A YEAR

COPYRIGHT, 1918

XUM

NATIONAL GEOGRAPHIC SOCIETY

HUBBARD MEMORIAL HALL

SIXTEENTH AND M STREETS, WASHINGTON, D. C.

O. H. TITTMANN . . . PRESIDENT
GILBERT H. GROSVENOR, DIRECTOR AND EDITOR
JOHN OLIVER LA GORCE . ASSOCIATE EDITOR
O. P. AUSTIN . . . . SECRETARY
JOHN E. PILLSBURY . . VICE-PRESIDENT
JOHN JOY EDSON . . . . TREASURER
GEORGE W. HUTCHISON, ASSISTANT SECRETARY
WILLIAM J. SHOWALTER . ASSISTANT EDITOR
RALPH A. GRAVES . . ASSISTANT EDITOR

BOARD OF MANAGERS

1916-1918

FRANKLIN K. LANE
Secretary of the Interior

WILLIAM HOWARD TAFT
Formerly President of the United States

C. M. CHESTER
Rear Admiral U. S. Navy, Formerly Supt. U. S. Naval Observatory

FREDERICK V. COVILLE
Formerly President of Washington Academy of Sciences

JOHN E. PILLSBURY
Rear Admiral U. S. Navy, Formerly Chief Bureau of Navigation

RUDOLPH KAUFFMANN
Managing Editor The Evening Star

T. L. MACDONALD
M. D., F. A. C. S.

S. N. D. NORTH
Formerly Director U. S. Bureau of Census

1917-1919

ALEXANDER GRAHAM BELL
Inventor of the telephone

J. HOWARD GORE
Prof. Emeritus Mathematics, The George Washington University

A. W. GREELY
Arctic Explorer, Major Gen'l U. S. Army

GILBERT H. GROSVENOR
Editor of National Geographic Magazine

GEORGE OTIS SMITH
Director of U. S. Geological Survey

O. H. TITTMANN
Formerly Superintendent of U. S. Coast and Geodetic Survey

HENRY WHITE
Formerly U. S. Ambassador to France, Italy, etc.

JOHN M. WILSON
Brigadier General U. S. Army, Formerly Chief of Engineers

1918-1920

CHARLES J. BELL
President American Security and Trust Company

JOHN JOY EDSON
Chairman of the Board, Washington Loan & Trust Company

DAVID FAIRCHILD
In Charge of Agricultural Explorations, Department of Agriculture

C. HART MERRIAM
Member National Academy of Sciences

O. P. AUSTIN
Statistician

GEORGE R. PUTNAM
Commissioner U. S. Bureau of Lighthouses

GEORGE SHIRAS, 3D
Formerly Member U. S. Congress, Faunal Naturalist, and Wild-Game Photographer

GRANT SQUIRES
New York

To carry out the purpose for which it was founded twenty-eight years ago, namely, "the increase and diffusion of geographic knowledge," the National Geographic Society publishes this Magazine. All receipts from the publication are invested in the Magazine itself or expended directly to promote geographic knowledge and the study of geography. Articles or photographs from members of the Society, or other friends, are desired. For material that the Society can use, adequate remuneration is made. Contributions should be accompanied by an addressed return envelope and postage, and be addressed:

GILBERT H. GROSVENOR, EDITOR

CONTRIBUTING EDITORS

A. W. GREELY
C. HART MERRIAM
O. H. TITTMANN
ROBERT HOLLISTER CHAPMAN
WALTER T. SWINGLE
ALEXANDER GRAHAM BELL
DAVID FAIRCHILD
HUGH M. SMITH
N. H. DARTON
FRANK M. CHAPMAN

Copyright, 1918, by National Geographic Society, Washington, D. C. All rights reserved.

Entered at the Post-Office at Washington, D. C., as Second-Class Mail Matter

A
B
C
D
1
2
3
4
5
6
7
NORTH SEA
CALAIS
Gravelines
Bourbourg-Ville
Audruicq
Wormhoudt
Cassel
Steenwoorde
Poperinghe
Hazebrouck
St. Omer
Lumbres
Aire
Fauquembergues
Hucqueliers
Fruges
Norrent-Fontes
Lillers
Hesdin
Le Parcq
St. Pol
Houdain
Bailleul
Merville
Bergues
Hoogstade
Loo
Proven
Elverdinghe
Nieuport
Ypres

E F G H I

H O L L A N

B

E

H
I
J
K
L
L
HOLLAND
Hulst
ANTWERP
Hoboken
GHENT
Termonde
Alost
MALINES
Vilvorde
BRUSSELS
Uccle
Hal
Enghien
Lessines
Ath
Nivelles
MONS
CHARLEROI
Gilly
Chatelet
Binche
VALENCIENNES
VERDUN
Grammont
Ninove
Wetteren
Eecloo
Waereghem

L M N O P Q

LUXEMBURG

LUXEMBURG

BOIS DU BON LIEU

FORET DE SPINCOURT

B. DE MERLES

FT. D'AMBLONVILLE

FT. DE WOEVRE

FORET DE LA REINE

FORET DE HAYE

FORET DE PUVENELLE

BOIS DU JURE

PONT-A-MOUSSON

Conflans-en-Jarnisy

Pont St. Vincent

Briey

METZ

NANCY

TOUL

NAMUR

MOSELLE

MEUSE

N O P Q R

LUXEMBURG

LUXEMBURG

METZ

DIEDENHOFEN

PONT-A-MOUSSON

NANCY

TOUL

1 2 3 4 5

R

INSET

SHOWING RELATION OF T
WESTERN THEATRE OF WA
THE SURROUNDING REGION
THE CONNECTION OF THE T
SECTIONS OF THE MAIN MA

LINE OF GREATEST C
ADVANCE IN 1914

BATTLE LINE BEFOR
DRIVE OF 1918

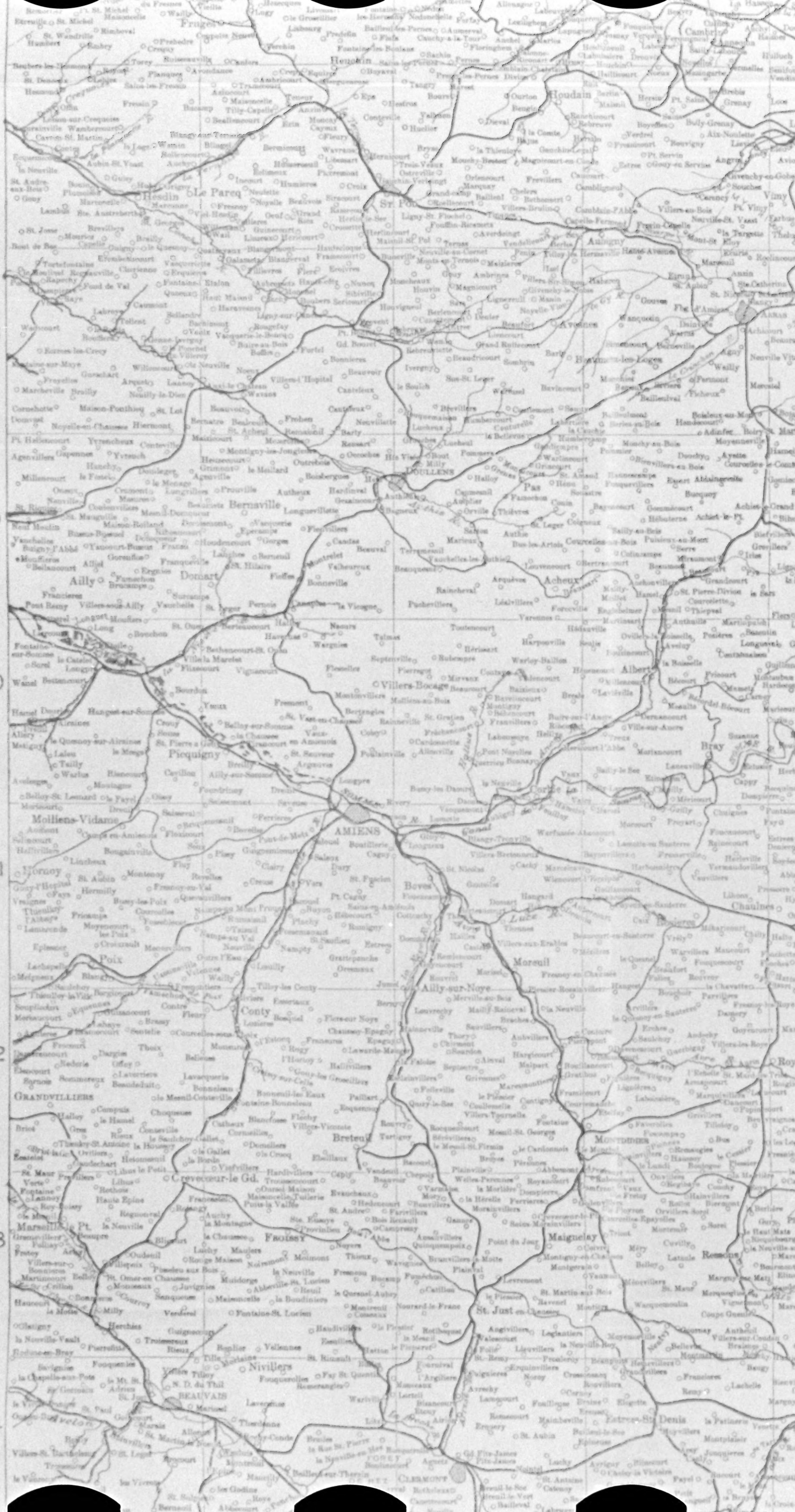
TERRITORY COVERED
SECTION OF MAIN

TERRITORY COVERED
SECTION OF MAIN

TERRITORY COVERED
SECTIONS OF MAIN

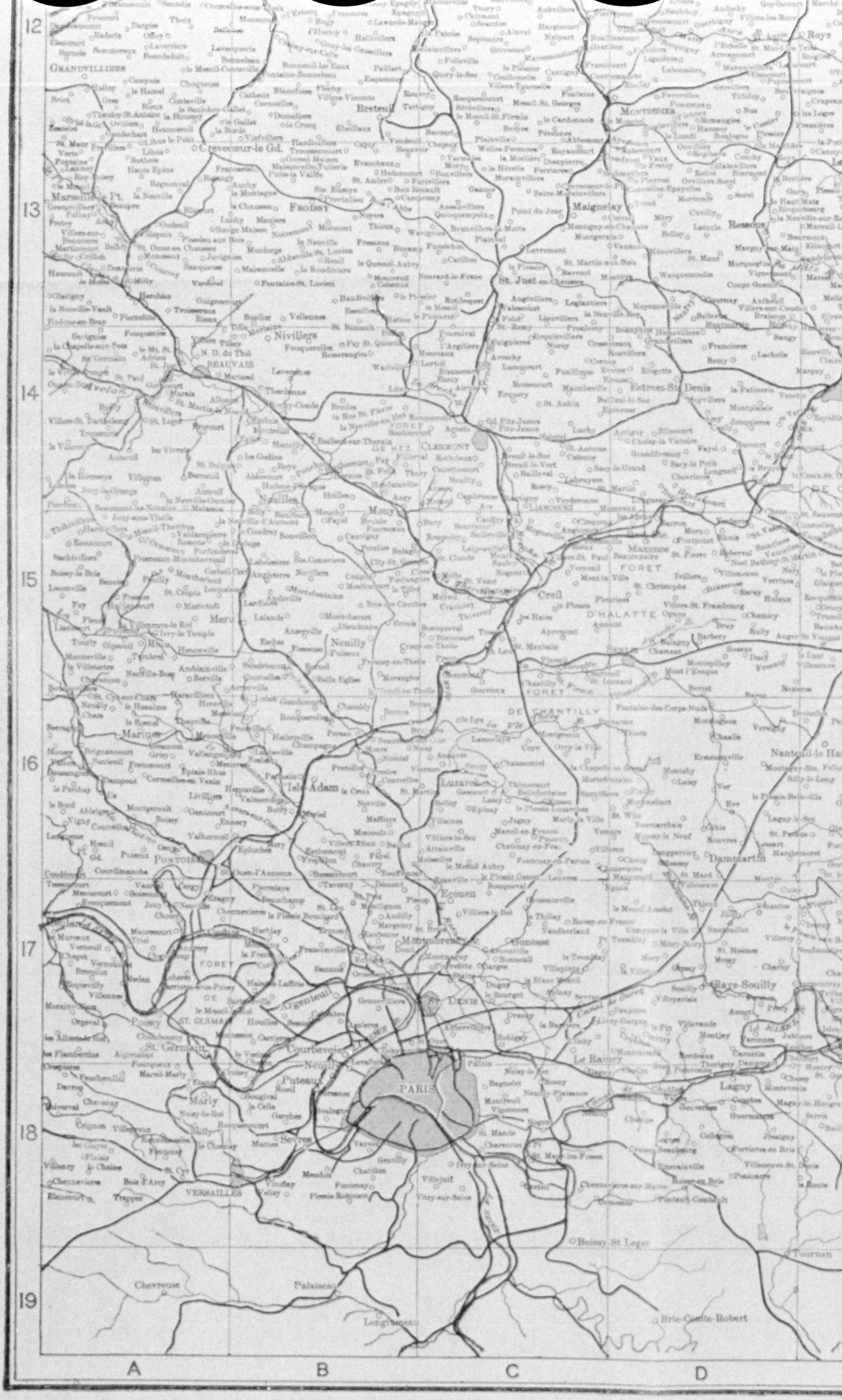
Statute Mi

London
NORTH SEA
The Hague
HOLLAND
Antwerp
Cologne
Paris
Le Havre
Nantes
Bordeaux
Toulouse
Marseille
Toulon
Lyon
Turin
Bern
SWITZERLAND
Golfe du Lion
Bilbao
Statute Miles
S
T
U
V
W
5
6
7
Drulingen
Lützelstein
Obermodern
Neuweiler
Bucheweiler
Hochfelden
Pfalzburg
Lixheim
Zabern
Maursmünster
Wasselnheim
Finstingen
Saarburg
Avricourt
Blamont
Vezouse


7
8
9
10
11
12
13
14
Frugès
Hesdin
Le Parcq
Heuchin
Houdain
Cambrin
Bernaville
Domart
Ailly
Doullens
Pas
Acheux
Albert
Villers-Bocage
Picquigny
Molliens-Vidame
AMIENS
Hornoy
Poix
Conty
Grandvilliers
Breteuil
Crevecœur-le Gd.
Froissy
Marseille Pt.
Nivillers
BEAUVAIS
Moreuil
Ailly-sur-Noye
Montdidier
Maignelay
St. Just en Chaussée
Roye
Chaulnes
Bray
Aumigny
Vimy
Arras
Albert
Fonquevillers
Courcelles-le-Comte
Achiet-le-Pt.
Bapaume
Puisieux-au-Mont
Grévillers
Irles
Miraumont
Grandcourt
Pys
Thiepval
Martinpuich
Pozières
Contalmaison
Longueval
Guillemont
Ginchy
Leuze Wd.
Combles
Rancourt
Sailly-Saillisel
Bouchavesnes
Cléry
Frise
Feuillères
Suzanne
Bussy-les-Daours
Corbie
Fouilloy
Warfusée-Abancourt
Lamotte-en-Santerre
Rainecourt
Harbonnières
Vermandovillers
Vauvillers
Proyart
Morcourt
Framerville
Chuignes
Cappy
Dompierre
Fay
Estrées
Framicourt
Bouvigny
Boyelles
Verdrel
Aix-Noulette
Liévin
Grenay
Loos
Souchez
Carency
Pt. Vimy
Neuville-St. Vaast
Thélus
Roclincourt
Ecurie
Marœuil
Annin
Ste. Catherine
Acq
Wailly
Beaurains
Agny
Neuville Vitasse
Boiry-Ste. Rictrude
Boiry-St. Martin
Boisleux-au-Mont
Boisleux-St. Marc
Adinfer
Moyenneville
Ayette
Courcelles-le-Comte
Gomiécourt
Hébuterne
Bihucourt
Bucquoy
Ablainzevelle
Gommecourt
Hannescamps
Monchy-au-Bois
Boiry-Becquerelle
Boiry-Notre-Dame
Ficheux
Berles-au-Bois
Bailleulval
Bailleulmont
Hamelincourt
Wanquetin
Dainville
Achicourt
Beaurains
Tilloy-les-Mofflaines
Neuville-Vitasse
Mercatel
Fampoux
Feuchy
Athies
Pelves
Monchy-le-Preux
Wancourt
Cherisy
Boiry-Ste. Rictrude
Ecoust-St. Mein
Croisilles
Hamelincourt
Bertincourt
Beugnâtre
Lagnicourt
Morchies
Boursies
Villers-Plouich
Gouzeaucourt
Metz-en-Couture
Trescault
Havrincourt
Flesquières
Graincourt
Anneux
Cantaing
Fontaine-Notre-Dame
Sailly
Raillencourt
Cuvillers
Haucourt
Rumilly
Oisy-le-Verger
Arleux
Palluel
Dury
Ecourt-St. Quentin
Lecluse
Arras
Ste. Catherine
Tilloy-les-Mofflaines
Neuville-Vitasse
Wailly
Agny
Beaurains
Achicourt
Roclincourt
Thélus
Farbus
Souchez
Vimy
Givenchy-en-Gohelle
Angres
Avion
Liévin
Loos
Haisnes
Hulluch
Vendin
Annay
Wingles
Noyelles-les-Vermelles
Loos-en-Gohelle
Sallaumines
Lens
Harnes
Carvin
Courrières
Evin-Malmaison
Dourges
Oignies
Drocourt
Rouvroy
Méricourt
Sallaumines
Noyelles-sous-Lens
Vendin-le-Vieil
Wingles
Annay
Vendin
Hulluch
Haisnes
Cuinchy
Pont-Fixe
Violaines
Vaudricourt
Gonnehem
Lestrem
Merville
Haverskerque
Estaires
Steenwerck
Bailleul
Nieppe
Armentières
Houplines
Frelinghien
Erquinghem-Lys
Lomme
Lille
Roubaix
Tourcoing
Wattrelos
Leers
Halluin
Linselles
Comines
Warneton
Ploegsteert
Wytschaete
Messines
Neuve-Eglise
Bailleul
Nieppe
Armentières
Houplines
Frelinghien
Erquinghem-Lys
Lomme
Lille
Roubaix
Tourcoing
Wattrelos
Leers
Halluin
Linselles
Comines
Warneton
Ploegsteert
Wytschaete
Messines
Neuve-Eglise

NANCY
TOUL
MOSELLE
Pont St. Vincent
St. Nicolas-du-Port
Dombasle
Bainville-sur-Madon
Colombey-les-Belles
Dieulouard
Pont-à-Mousson
Blainville-sur-l'Eau
Gerbéviller
Baccarat
Baron
Charmes
Mirecourt
Dompaire
Neufchâteau
Rambervillers
Châtel-sur-Moselle
Epinal
Ft. d'Epinal
Bruyères
Plombières-les-Bains
Remiremont
Xertigny
Florenville
Montmédy
Stenay
Beaumont
Buzancy
Sedan
Mouzon
Raucourt
Vaux
Luxeuil
Fougerolles
Lure
Marville
Jarny
Conflans
Briey
Longwy
Etain
Verdun
Commercy
Vaucouleurs
Gondrecourt
Void
Ligny
Bar-le-Duc
Clermont
Varennes
Ste. Menehould
Grandpré
Vouziers
Rethel
Mézières
Charleville
Givet
Rocroi
Hirson
Guise
Vervins
Laon
Soissons
Château-Thierry
Meaux
Paris
Versailles
Rambouillet
Dreux
Evreux
Pont-Audemer
Lisieux
Caen
Bayeux
Cherbourg
Valognes
Carentan
St. Lô
Coutances
Granville
Avranches
Mont St. Michel
Pontorson
Fougères
Vitré
Laval
Mayenne
Château-Gontier
Segré
Angers
Saumur
Chinon
Loudun
Thouars
Parthenay
Niort
La Rochelle
Rochefort
Marennes
Oléron
Ile de Ré
Fontenay-le-Comte
Luçon
Les Sables-d'Olonne
Challans
Pornic
Paimbœuf
Nantes
Clisson
Montaigu
Cholet
Bressuire
Airvault
Melle
Ruffec
Confolens
Angoulême
Cognac
Jarnac
Barbezieux
Blaye
Bourg
Libourne
Pauillac
Lesparre
Soulac
Arcachon
La Teste
Biscarrosse
Mimizan
Dax
Orthez
Pau
Oloron
Mauléon
Tarbes
Lourdes
Bagnères-de-Bigorre
Luchon
St. Gaudens
Muret
Toulouse
Carcassonne
Narbonne
Béziers
Agde
Cette
Montpellier
Lunel
Aigues-Mortes
Arles
Tarascon
Beaucaire
Nîmes
Uzès
Alais
Le Vigan
Lodève
Bédarieux
St. Pons
Mazamet
Castres
Albi
Gaillac
Montauban
Moissac
Agen
Marmande
La Réole
Bazas
Langon
Bordeaux
Blanquefort
Lesparre
Pauillac
Soulac
Arcachon
La Teste
Biscarrosse
Mimizan
Dax
Orthez
Pau
Oloron
Mauléon
Tarbes
Lourdes
Bagnères-de-Bigorre
Luchon
St. Gaudens
Muret
Toulouse
Carcassonne
Narbonne
Béziers
Agde
Cette
Montpellier
Lunel
Aigues-Mortes
Arles
Tarascon
Beaucaire
Nîmes
Uzès
Alais
Le Vigan
Lodève
Bédarieux
St. Pons
Mazamet
Castres
Albi
Gaillac
Montauban
Moissac
Agen
Marmande
La Réole
Bazas
Langon
Bordeaux
Blanquefort

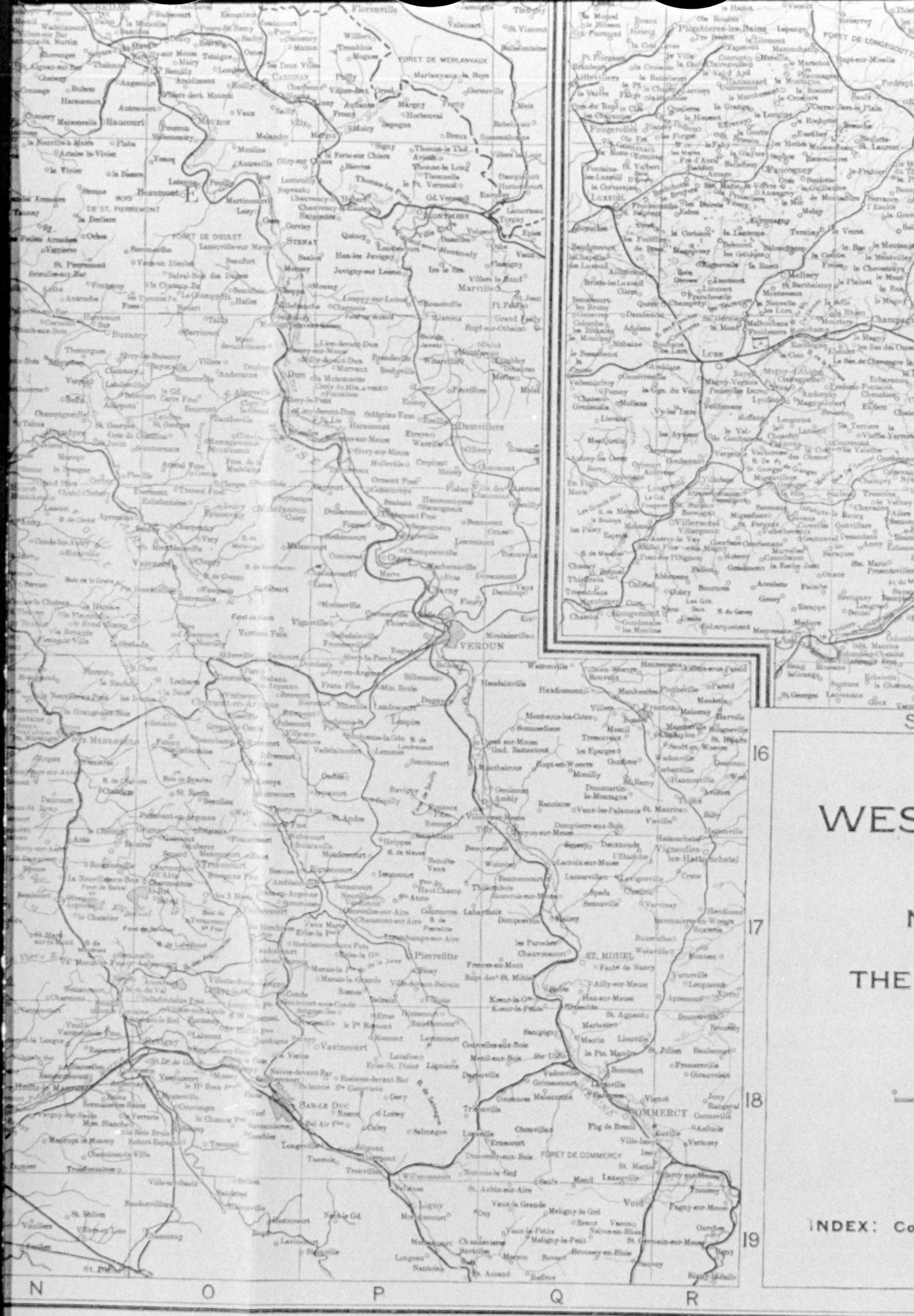
7
8
9
10
11
12
13
14


12
13
14
15
16
17
18
19
A
B
C
D
GRANDVILLIERS
Breteuil
MONTDIDIER
Roye
Crevecœur-le Gd.
Marseille-le Pt.
FROISSY
Maignelay
Ressons
St. Just-en-Chaussée
Nivillers
BEAUVAIS
Estrées-St. Denis
CLERMONT
Nouilles
Mouy
Maxence
FORET
Creil
D'HALATTE
Meru
Neuilly
Marines
Isle-Adam
Luzarches
Nanteuil-le Haut
PONTOISE
Dammartin
Ecouen
Montmorency
Gonesse
Glaye-Souilly
Argenteuil
St. Denis
Poissy
St. Germain
Courbevoie
Le Raincy
Puteaux
PARIS
Lagny
Marly
Sèvres
VERSAILLES
Boissy-St Leger
Tournan
Chevreuse
Palaiseau
Longjumeau
Brie-Comte-Robert

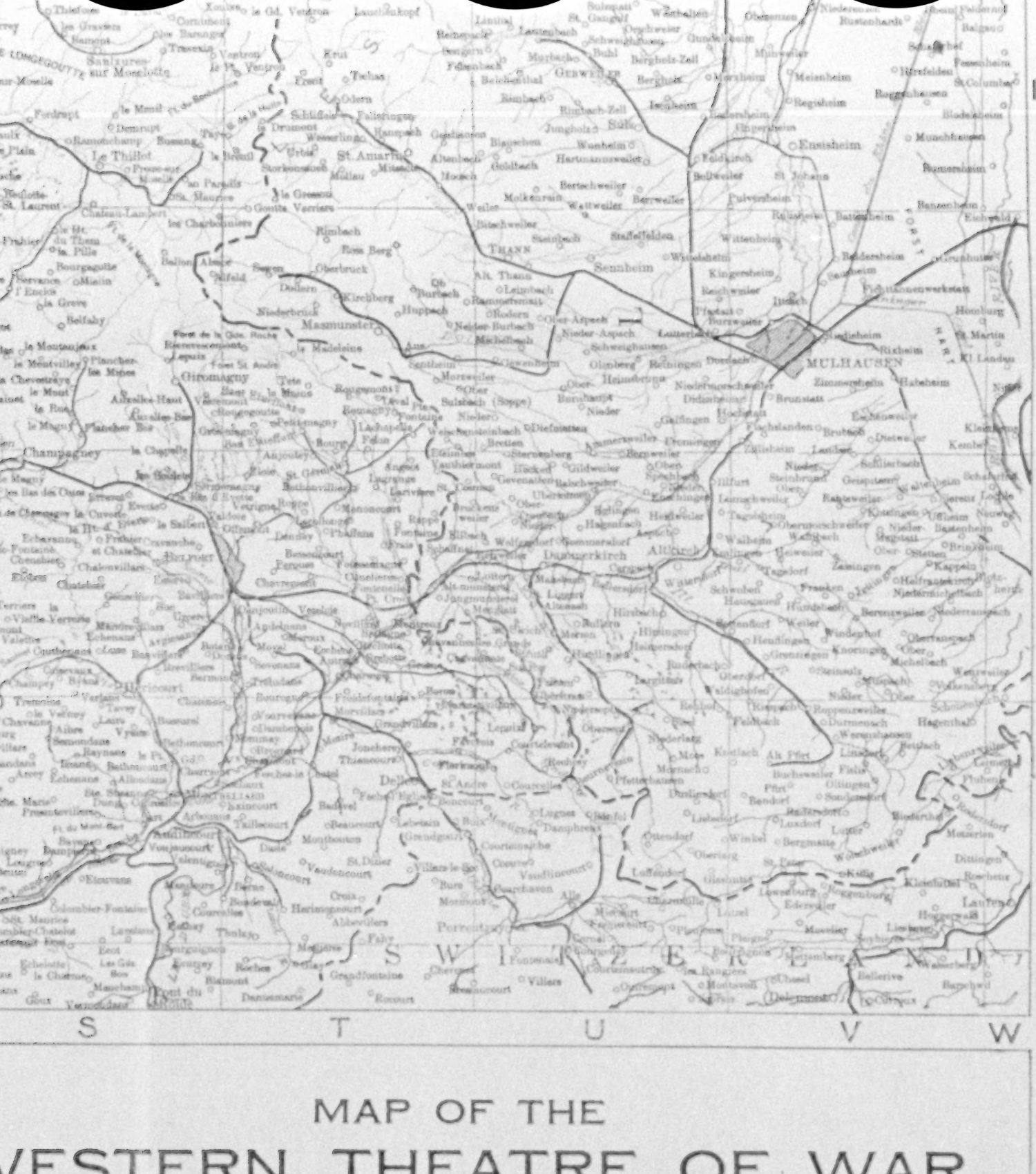
Roye
Lassigny
Noyon
Guiscard
Chauny
Ribecourt
FORET DE LAIGLE
COMPIEGNE
FORET DE COMPIEGNE
Coucy-le-Chateau
Crecy-sur-Serre
LAON
Bruyeres
Vailly
SOISSONS
Braine
Fismes
Villers Cotterets
Crepy-en-Valois
Oulchy
Neuilly
Fere-en-Tardenois
Ville-en-Tardenois
Chatillon-sur-Marne
Betz
Nanteuil-le-Haudouin
Lizy
CHATEAU THIERRY
Conde-en-Brie
Charly
La Ferte
Meaux
Montmort
Montmirail
Rebais
Crecy
COULOMMIERS
La Ferte-Gaucher
Esternay
Sezanne
Tournan
Rosoy
Dagny
Courtacon
St. Bon
E
F
G
H
I

LAON
Sisonne
CAMP DE SISSONNE
FORET DE SAMOUSSY
N. D. de Liesse
Chateau Porcien
Chaumont-Porcien
Novion-Porcien
RETHEL
Asfeld-la Ville
Neufchatel-sur-Aisne
Craonne
Vailly
Braine
Fismes
Warmeriville
Juniville
Machault
Bourgogne
REIMS
Beine
St. Hilaire-le Petit
Fere-en-Tardenois
Ville-en-Tardenois
Verzy
FORET DE LA MONTAGNE DE REIMS
Mourmelon-le Grand
Suippes
CAMP DE CHALONS
Chatillon-sur-Marne
Dormans
Dizy-Magenta
Epernay
MARNE
Avize
Vertus
CHALONS-SUR-MARNE
Montmort
Conde-en-Brie
Montmirail
Sezanne
Esternay
Fere-Champenoise
Sompuis
VITRY-LE FRANCOIS
H
I
J
K
L

VERDUN
BAR-LE-DUC
ST. MIHIEL
STENAY
MOUZON
CARIGNAN
MONTMEDY
Florenville
Raucourt
Beaumont
Buzancy
Vouziers
Grandpré
Varennes
Montfaucon
Damvillers
Dun
Le Chesne
Tourteron
Attigny
Suippes
STE MENEHOULD
Clermont-en-Argonne
Revigny
Heiltz-le-Maurupt
Vavincourt
Pierrefitte
Ligny
FORET DE MAZARIN
FORET DE DIEULET
FORET DE MERLANVAUX
FORET DE COMMERCY
M
N
O
P
Q



Florenville
Raucourt
Beaumont
Montmedy
Stenay
Marville
Damvillers
Dun
Montfaucon
Varennes
Charny
VERDUN
Fresnes
Pierrefitte
Vavincourt
Revigny
Bar-le Duc
Ligny
Commercy
Void
Lure
Luxeuil
Fougerolles
Faucogney
Plombieres-les-Bains
Rougemont
Villersexel
Vigneulles-les-Hattonchatel
Ste Menehould
Clermont-en-Argonne
Triaucourt
Vaucouleurs
Bois de St. Pierremont
Forêt de Dieulet
Forêt de Merlanvaux
Forêt de Commercy
Forêt de Longegoutte
16
17
18
19
N
O
P
Q
R
WES
THE
INDEX: Co



MAP OF THE
VESTERN THEATRE OF WAR

PREPARED IN THE MAP DEPARTMENT

OF THE

NATIONAL GEOGRAPHIC SOCIETY

FOR

THE NATIONAL GEOGRAPHIC MAGAZINE

GILBERT GROSVENOR, EDITOR

A. H. BUMSTEAD, CARTOGRAPHER

SCALE 1 : 458,124 APPROXIMATELY 7¼ MILES TO 1 INCH

0 5 10 15 20 25 30

STATUTE MILES

(THE MAP IS DIVIDED INTO 10 MILE SQUARES)

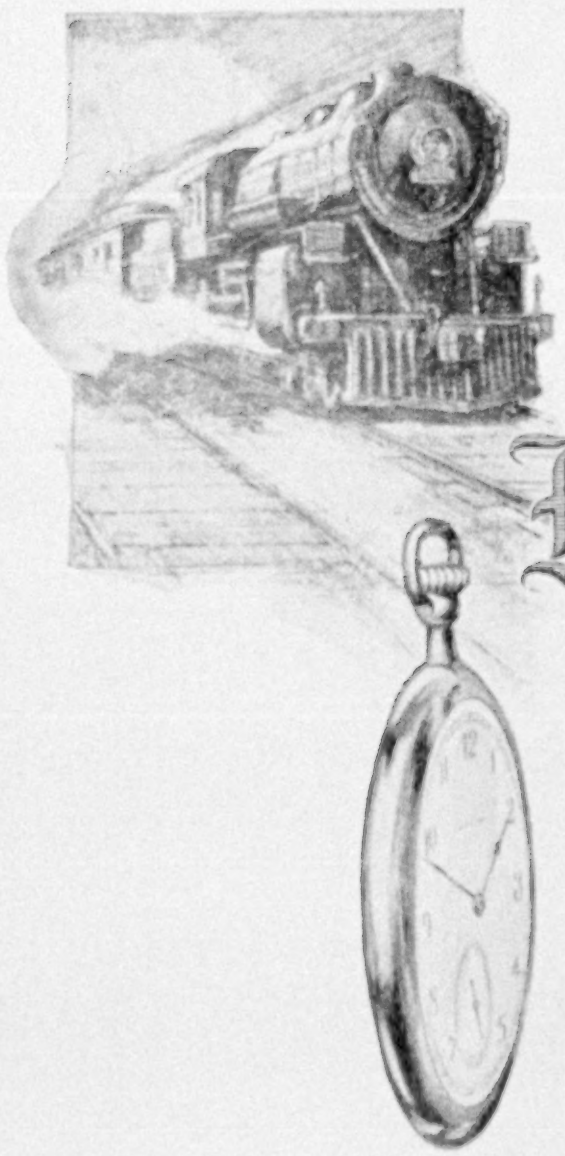
RAILROADS TRAM LINES

COPYRIGHT, NATIONAL GEOGRAPHIC SOCIETY, WASHINGTON, D. C., 1918

EX: Complete alphabetical index of all names available upon request, by mail Twenty-five Cents

XUM

The Watch that Times America's Trains



What watch do you carry? How accurately does it keep time? Would you carry the same watch if your life depended upon the accuracy of your watch?

Your life actually does depend upon the accuracy of the watch carried by the engineer who runs your train. So does his own life. And so do the lives of all the travelers.

That is why Official Time Inspection is maintained on 95 per cent of America's railroad mileage and why most of the engineers, conductors and trainmen carry Hamiltons.

Hamilton Watch

"The Railroad Timekeeper of America"

The watch that with uninterrupted safety and accuracy times America's trains, which represent 40 per cent of the trains of the world, is the best watch for the modern American who values absolute dependability and infinite perfection in his timepiece.

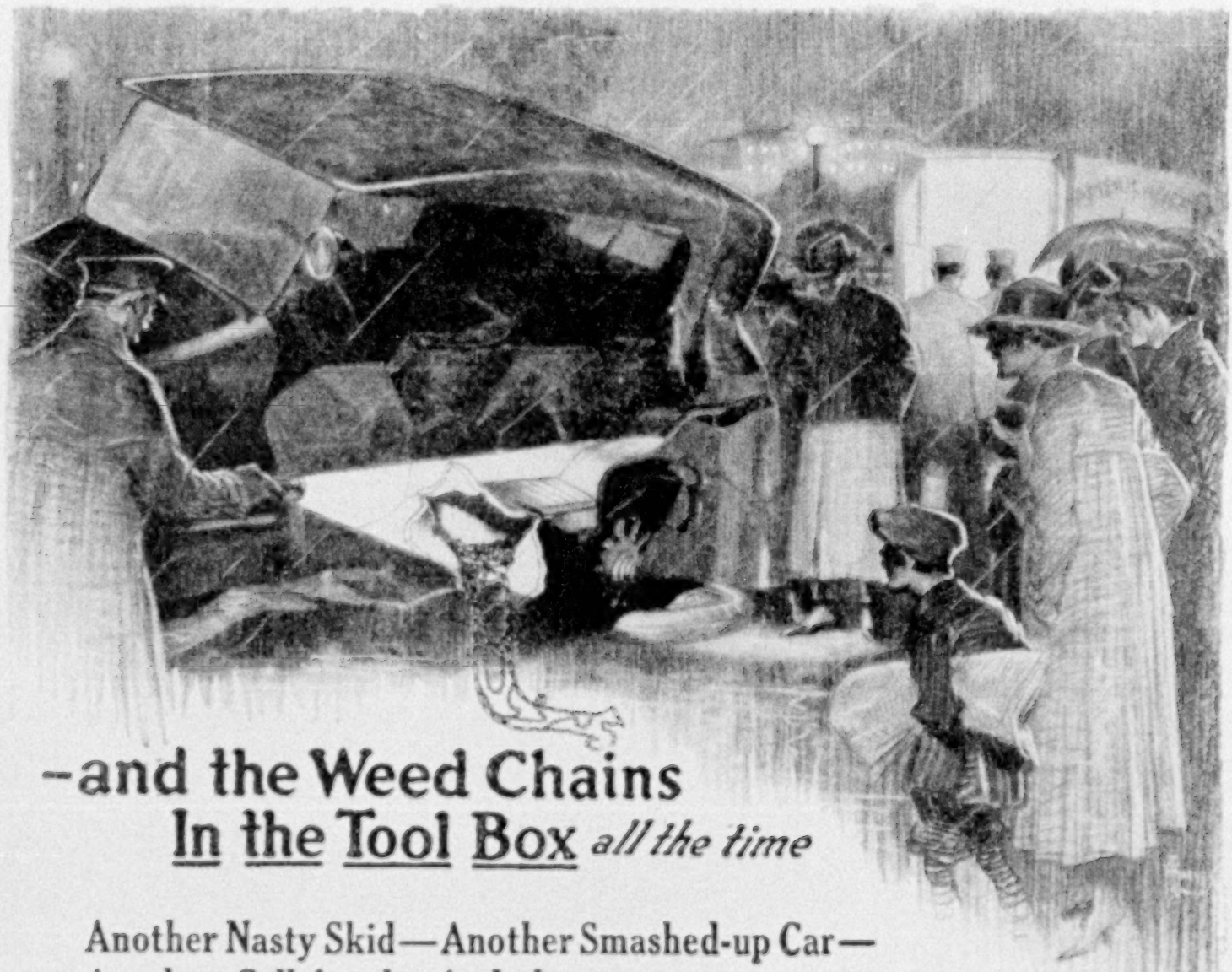
The man who carries a Hamilton has the satisfaction of knowing that he owns a watch by which his friends will set their watches. If you don't own a Hamilton, you're losing time.

There are 32 Hamilton Models to choose from. They range in style from rugged utility to objects of extraordinary artistic beauty. A life-time of continuous service in a life-long possession of charm.

Prices, $28 to $150. Movements, $15 ($17 in Canada) and up. Sold by all leading jewelers everywhere.

Send today for "The Timekeeper"—the story of Hamilton supremacy

HAMILTON WATCH COMPANY
Department 35
LANCASTER PENNSYLVANIA



–and the Weed Chains In the Tool Box *all the time*

Another Nasty Skid—Another Smashed-up Car—Another Call for the Ambulance.

Will Motorists never learn to take warning from the experience of others?

A chainless car on a slippery pavement is an ***uncertain car.*** You know this as well as we do, and are expected to be prepared.

Being prepared doesn't merely mean carrying tire chains in your tool box—what earthly good can they do there?

When It's Wet or Slippery Tire Chains Belong *On the Tires*

You shouldn't hesitate a moment in hauling them out of the tool box ***at the first drop of rain.*** Use *P*recaution as well as *C*aution.

You are to blame if your car skids. ***You*** are responsible if it swings into a pedestrian.

For Safety's Sake Put Chains on Your Tires

AMERICAN CHAIN COMPANY, Inc.

Bridgeport Connecticut

In Canada: Dominion Chain Company, Limited, Niagara Falls, Ontario

Largest Chain Manufacturers in the World

The Complete Chain Line—All Types, All Sizes, All Finishes—From Plumbers' Safety Chain to Ships' Anchor Chain.

MARMON 34

Advanced Engineering

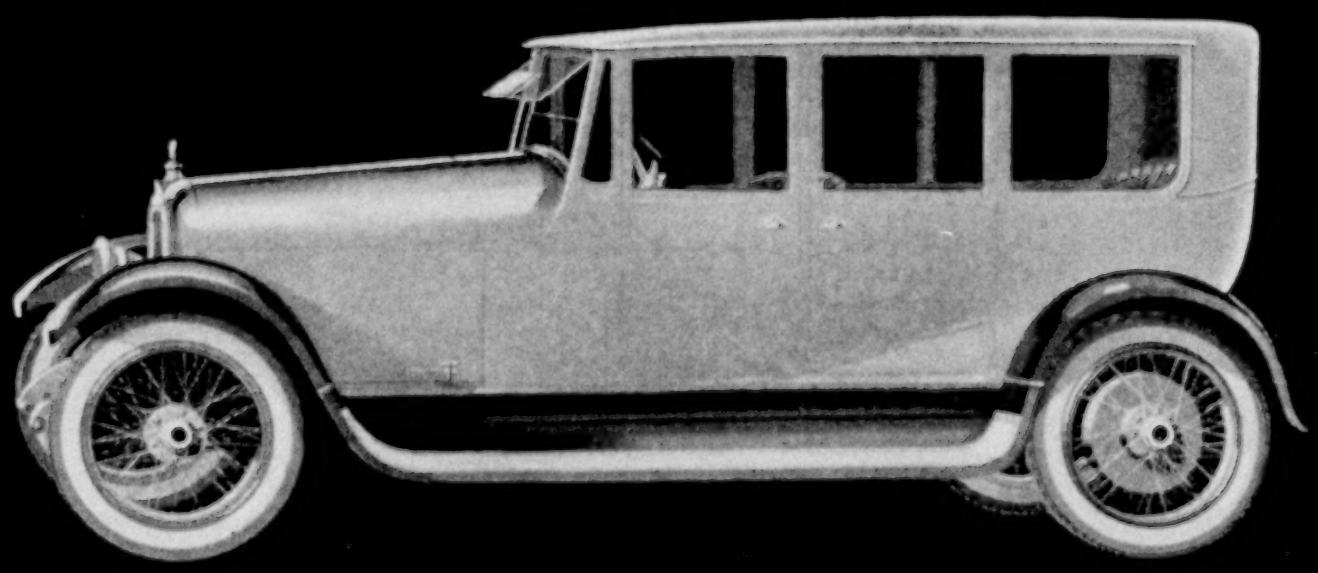
The new 4-Door Sedan is a practical family car for all seasons. In pleasant weather the lowered windows give the effect of an open car; when raised on stormy days, they shut out all discomforts. This serviceable model is in full accord with the utilitarian spirit of today.

136-inch wheelbase—
1100 pounds lighter

NORDYKE & MARMON COMPANY

Established 1851

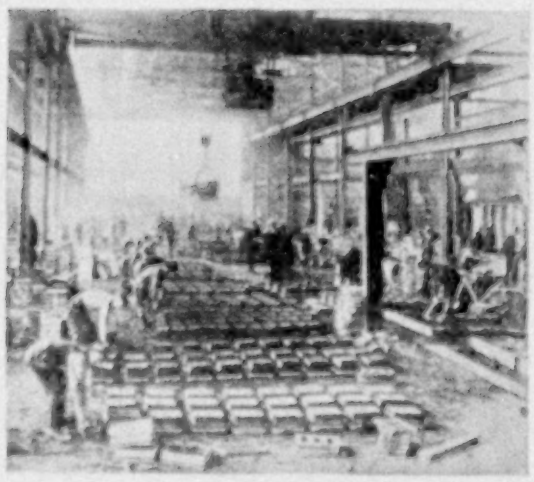
INDIANAPOLIS



XUM

Fenestra

SOLID STEEL WINDOWS



Cool air thru the side ventilators replaces fumes and gases which rise steadily to the monitor exits of this foundry

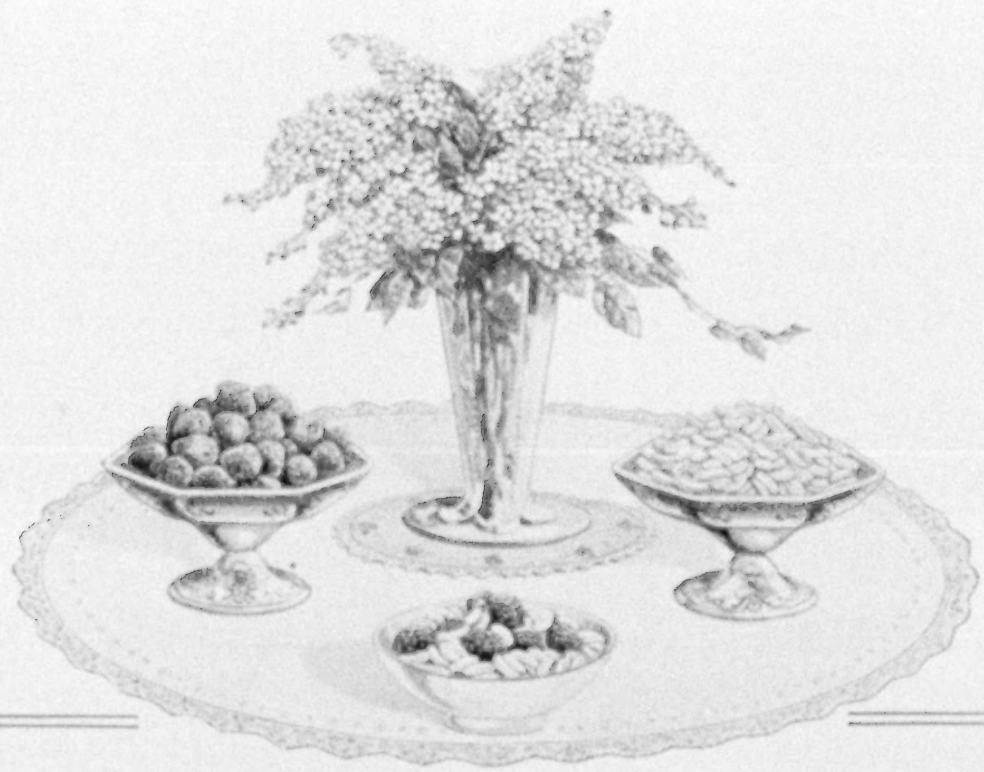
Here is real foundry ventilation— that sure exit of noxious gases and smoke, as well as intake of pure air which health and efficiency demand.

The upper vents of *Fenestra Solid Steel Windows*, opening ninety degrees, provide an irresistible outlet for smoke and gases while the lower vents pour fresh air into the building. And with this, *Fenestra Windows* afford perfected fire protection besides permitting daylight to flood every inch of floor space. Get the full facts by addressing

Detroit Steel Products Company

3719 East Grand Boulevard, Detroit

Fenestra Operators are designed and built as a part of Fenestra Sash. Descriptive catalog on request



Puffed Rice Dishes for
Lilac Time

About lilac time the demand for Puffed Rice reaches zenith. Don't miss it for a day.

Every dish of berries calls for these crisp, flaky bubbles. Without them it's like shortcake minus crust.

Every bowl of milk, at noon or night, needs these airy, toasted globules. Nothing else has half of their delights.

Just Grain Puffs—Nothing Added

Puffed grains are so flavory, so enticing, that they hardly seem like grain foods. But they are.

Puffed Rice is simply whole rice steam-exploded—puffed to eight times normal size. Its flavor is due to a fearful heat—its flimsiness to puffing.

It means a whole-grain food, easily digestible. Every food cell is exploded.

No riceless meals or riceless days are called for. So Puffed Rice—also Corn Puffs—can be daily delights.

Let children and grown-ups enjoy them to the full. It's the ideal form of grain food and the form which they prefer.

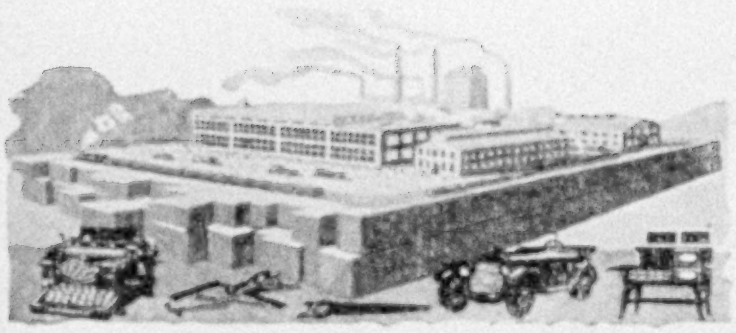
In summer-time serve them in abundance.

Puffed Rice **Corn Puffs** **Puffed Wheat**

Each 15c Except in Far West

[1809]

XUM



Steel is the Foundation of Industry - save it

AMERICAN INDUSTRY—particularly that part of American industry indispensable to the war—must have steel in large quantities. It is the basic material—the foundation upon which rests nine out of ten of our great manufacturing institutions.

If the supply of all other metals had to be cut off forever—if we could hand down only one metal as a birthright to future generations—there could be but a single answer—*steel.*

And yet government figures show that right now approximately 23% of all steel rusts away annually—a needless and unforgivable waste.

Steel Need Not Rust!

Leading manufacturers—concerns in practically every line of metal-working activity—have proved that steel does not need to rust—that rust can easily be prevented by use of the Parker Process.

If you buy your equipment new today from the leaders in their respective fields, the lock in your front door, the typewriters in your office, the exposed metal parts in your automobile, and the steel range in your kitchen will soon convince you with their mute testimony that rust is no longer necessary—that the Parker Process does prevent rust.

A Book On Rust Proofing for Industrial Executives

Manufacturers and industrial executives who are concerned with the rust-proofing problem will find much of interest in the recently published Parker Process book. This book explains in detail how the Parker Process does its work—who the large manufacturers are that use the Parker Process—and how easily the Parker Process can be applied to your own production without in any way interfering with your present manufacturing plans.

For your copy of this comprehensive book address

Parker Rust Proof Company
of America
Detroit Michigan U. S. A.

PARKER PROCESS
RUST PROOFS IRON AND STEEL

Renew and Decorate masonry exteriors—stucco, concrete, or brick—with the liquid cement-coating, Trus-Con Stone-Tex. Formulated specifically for masonry surfaces; becomes an inseparable part of the wall, sealing all pores and filling hair-cracks. Unlike paints, it damp-proofs as well as beautifies. Therefore cannot chip, flake, or peel off.

Furnished in many pleasing colors. Applied to new or old walls. One of the Famous Trus-Con water-proofing and damp-proofing products—sufficient assurance of quality.

If your brick, Stucco, or cement building is disfigured, damp and unsanitary, use Stone-Tex. Write for full information, telling your needs.

THE TRUS-CON LABORATORIES
178 Trus-Con Building Detroit, Michigan

We specialize in unusual paint requirements. Write for advice.

Renew Masonry Walls With
STONE TEX

DON'T BE ASHAMED
of your garbage can

Your garbage can should be just as unnoticed and just as sanitary as the rain spouts on your house. Witt's meets these requirements. It won't rust and won't dent. Made of heavy galvanized, corrugated steel—29 times stronger than plain steel. It outlasts two ordinary cans. Witt's lid fits air-tight. Keeps odors in; keeps dogs, rats, flies out. Buy Witt's for your home. It saves you money. Write for Booklet and name of nearest Witt dealer.

THE WITT CORNICE CO.
Dept. B
Cincinnati, Ohio

WITT'S CAN & PAIL

BONDS LEGAL

for

N. Y. State and Massachusetts Savings Banks

Also Suitable for Trust Funds

For the convenience of investors we have combined in booklet form the official lists of Bonds Legal in New York and Massachusetts, which will be sent upon request.

Ask for Bonds Legal, AN-68.

The National City Company

National City Bank Building, New York

Correspondent Offices in 24 Cities

Bonds *Short-Term Notes* *Acceptances*

Booklets You Should Have

EVERY investor should have a copy of our valuable new book, "Safety and 6%," telling how the *Straus Plan* has protected investors for thirty-six years without the loss of a dollar. Write for it, together with our booklet, "Acid Tests of Investments in War Time" and our current Investment List, describing sound first mortgage 6% serial bonds, in $1,000, $500 and $100 amounts. Ask for

Offering No. E-808

S.W. STRAUS & CO.

Established 1882 Incorporated

NEW YORK 150 Broadway

CHICAGO Straus Building

Detroit Minneapolis San Francisco Philadelphia Kansas City

36 years without loss to any investor

FREE BOOK ON BIRDS AND BIRD HOUSES

WRITE for your copy today.

If your reply reaches me early, I will enclose a beautiful bird color plate. Have you ever known the pleasure derived from a colony of Purple Martins? They will clear your shrubs, trees and grounds of mosquitoes. The house illustrated never fails to get the Martins. A remarkable value, 28 apartments, 32 in. by 27 in., this month for $12. There is a

DODSON BIRD HOUSE

for every kind of bird. No grounds are quite complete without the song birds. Furnish them with safe homes and they will come back to you season after season. Learn all about how to attract the song birds from my Free Book.

JOSEPH H. DODSON, *Pres. American Audubon Association*
702 Harrison Avenue, Kankakee, Ill.

Dodson's Sparrow Trap guaranteed to rid your community of these grain-eating pests. Price, $5.

Government and Municipal Bonds

Just At This Time

Present high interest returns, and exceptional opportunities for investment have resulted from extensive government financing and will probably cease to exist when normal conditions return.

Municipal Bonds

offer unusually attractive returns. Our latest list affords a wide selection of issues free from Federal Income Taxes yielding 4½% to 6%. Denominations, $100, $500, and $1,000.

Government Bonds—All Issues

Send for booklets, "Bonds As Safe As Our Cities" and "A Nation at War—Its Financial Needs."

Address Dept. N-5.

William R. Compton Co.

Government and Municipal Bonds

"Over a Quarter Century in This Business"

NEW YORK 14 Wall Street

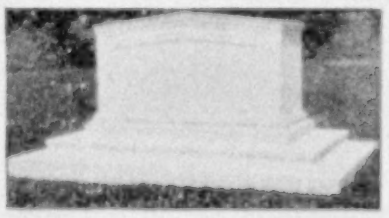
ST. LOUIS 408 Olive Street

CHICAGO 105 So. La Salle Street

CINCINNATI 305 Union Trust Bldg.

PITTSBURGH: Farmers Bank Building

QUALITY - - PERSONAL SERVICE



Request Booklet 3, a dependable guide in the selection of a Private or Public Memorial.

HARRISON GRANITE COMPANY

200 Fifth Avenue New York City

Offices in principal cities. Works: Barre, Vt.

XUM

COPYRIGHT 1914 BY THE PROCTER & GAMBLE CO., CINCINNATI

FOR the gifts of silver, glass, china, linen—for all remembrances priceless in the fond friendships they recall, the mild pure safe Ivory is peculiarly appropriate. Free from every injurious material, yet able to make dirt vanish in its copious suds without the help of harmful scouring and rubbing, Ivory Soap takes care of valued keepsakes as if it had the power to feel its user's fondness for them.

IVORY SOAP.. IVORY IT FLOATS ..99 44/100% PURE

VOL. XXXIII, No. 5 WASHINGTON MAY, 1918

THE NATIONAL GEOGRAPHIC MAGAZINE

SMALLER MAMMALS OF NORTH AMERICA

By EDWARD W. NELSON
CHIEF, U. S. BIOLOGICAL SURVEY

With illustrations in color from paintings by Louis Agassiz Fuertes

This series of animal biographies and natural-color portraits is a counterpart of the series dealing with the Larger North American Mammals, published in the November, 1916, NATIONAL GEOGRAPHIC MAGAZINE. *Together they describe and illustrate the most interesting and characteristic types of North America's mammal life. The author of these intimate insights into animal nature, Mr. E. W. Nelson, for forty years the friend and student of the people of the wild, brings to* GEOGRAPHIC *readers a refreshing picture of their habits, their traits, and their environment. He has studied them from northernmost Alaska to southernmost Mexico. The paintings are by Mr. Louis Agassiz Fuertes, whose work is always received with enthusiasm by* GEOGRAPHIC *readers everywhere, and the illustrations of the animal tracks by our foremost American authority, Ernest Thompson Seton.*

IN THAT part of North America lying north of Mexico more than 1,300 species and geographic races of mammals are known to exist. Of these by far the greater number, both of species and individuals, fall into the class of smaller mammals.

Some of the most characteristic types which appear to have originated in North America are the mountain-beavers, pocket-gophers, kangaroo-rats, pocket-mice, wood-rats, white-footed mice, muskrats, skunks, and ring-tailed cats.

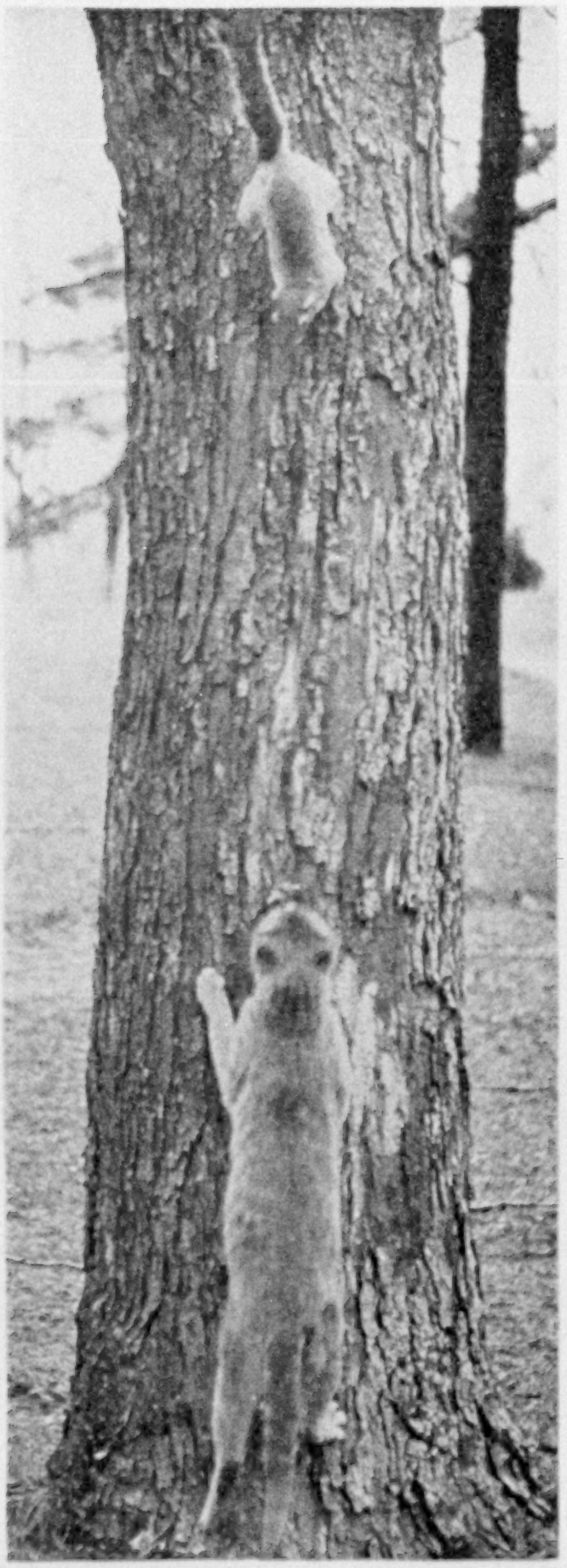
In Siberia and Europe live close counterparts of our northern weasels, minks, martens, field-mice, lemmings, northern hares, conies, marmots, moles, and others; and on our southern border the armadillo and the hog-nosed skunk introduce a faint tinge of a strange fauna from South America.

FURRY FRIENDS AND ENEMIES

The muskrats, minks, martens, and skunks for many years have yielded an enormous annual return from their furs; the squirrels and rabbits afford sport and a large supply of excellent flesh for food; the prairie-dogs and some of the ground-squirrels existing in enormous numbers have been excessively destructive to crops; and others, like the porcupine and the armadillo, have attracted particular attention because of their strange characteristics.

The smaller mammals live everywhere, from the tropical end of Florida to the uttermost lands of the frozen North, and from the seashore to the limit of vegetation on the high mountains. The heaviest forests, open meadows, rugged mountain slopes, arctic barrens, and sun-scorched desert plains all have their small

XUM



Photograph by Howard Taylor Middleton

HEREDITARY ENEMIES: A CAT WATCHING A GRAY SQUIRREL

At one time the gray squirrel was so abundant as to make ruinous inroads on the corn and wheat crops of our pioneers. In Ohio, a hundred years ago, there was a law requiring each free white man to deliver 100 squirrel scalps every year or pay a penalty of $3. Today the gray squirrel needs legal protection to prevent its extermination.

four-footed habitants. Many modifications of parts and organs of the various species have been necessary to adapt the small mammals to specialized modes of life.

ANIMALS THAT LEARNED TO "DIG IN"

This is strikingly illustrated in the case of those true rodents, the pocket-gophers, which apparently found competition on the surface of the ground so acute that they took the unoccupied territory below the surface, where they live as miners and tunnel from place to place in search of edible roots, with an occasional stealthy excursion above ground to seize some of the food available there.

Another excellent illustration is furnished by the moles, which, leaving the numerous closely related species—the shrews—to feed upon insects above ground, have descended and, like the pocket-gophers, live in tunnels which they make in the pursuit of earthworms and insects below the surface; like the gophers, they, too, make occasional excursions above ground in search of food.

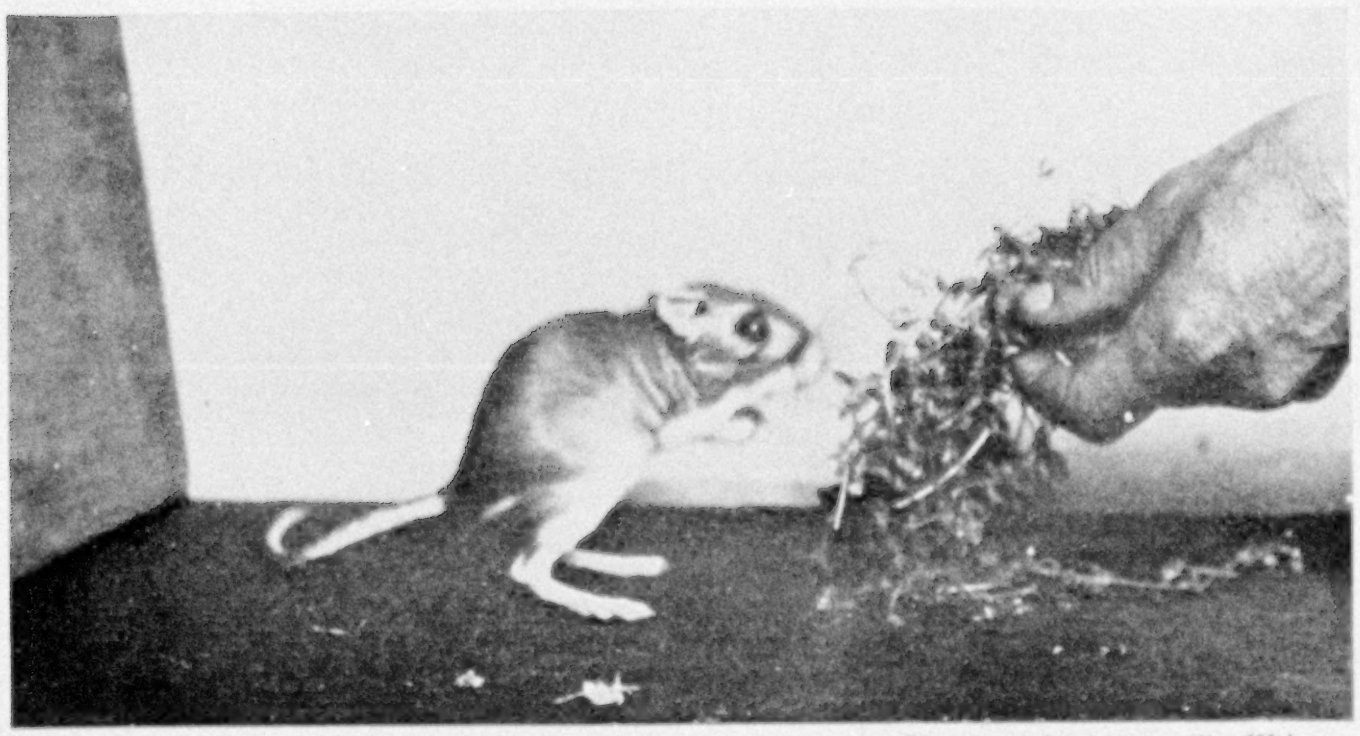
The mink and the muskrat, representing the carnivores and rodents, have rivals for their food supply on land and have become amphibious, being as much at home in the water as on shore, one feeding on fish and flesh and the other on aquatic vegetation. Certain forms of the squirrel tribe are heavy-bodied and live in underground burrows, while other more slender and graceful species make their homes in the tree-tops.

A DEPARTURE FOR EVERY NEED

Another member of this group, the flying-squirrel, has developed an extension of the skin uniting the front and hind legs, so it may glide freely from tree to tree. The bats have gone still further, and the skin uniting their lengthened front and hind limbs and long finger bones forms broad wings which lend them powers of flight scarcely equaled by those of birds.

The gophers, pocket-mice, chipmunks, and others are provided with little cheek pouches in the skin on each side of the mouth, in which they may carry food home to their store-rooms and other hiding places.

The hares have developed long legs for running on open plains, and the weasels have long, slender bodies and an exceed-



Photograph from Ernest Elva Weir

A HAND-FED KANGAROO-RAT

These curious little desert rodents have many interesting habits, one of the most fascinating being their method of combat. Sitting on their hind feet, after the fashion of kangaroos, the belligerents hop around each other, sparring for an opening, finally striking out with their long feet like game cocks. When a kick lands fairly, the victim rolls over as if ready to "take the count."

ing quickness which enables them to follow and capture their elusive prey in its burrows and among crevices in the rocks.

The hairy coat of the mole is short and equal to the finest velvet, while that of the porcupine stands out in strong, sharp spines; the skin of the armadillo is practically hairless, but forms a bony armor covering its upper parts.

The front feet of squirrels and most other rodents are slender and used with deftness as hands in manipulating food, while those of the badger and skunk are heavily clawed and strongly muscled for the purpose of digging up their prey.

The tails of many species are varied in form to serve special purposes. The long-haired tails of tree-squirrels have a plume-like character, which adds much to the beauty of these attractive animals. The long tails of the kangaroo-rats and the jumping-mice serve as balances for their bodies during long leaps. The vertically flattened tail of the muskrat and the broad horizontally flattened tail of the beaver are useful as rudders. Perhaps the oddest of all is the naked prehensile tail of the opossum, which coils about branches or other support and thus is a safeguard against a possible fall, and even permits the animal to hang suspended by it alone.

STRANGE ADAPTATIONS TO MEET CONDITIONS OF ENVIRONMENT AND COMPETITION

In such ways, by thousands of adaptations and modifications of the typical four-footed mammal, are they fitted to their varied modes of life, each so far as possible in some special place of its own.

The effect of the pressure of environment and competition upon the various species of mammals in any region could not be better shown than by the kangaroos of Australia. That continent is occupied by many species of these peculiar mammals, some of which inhabit the open plains like our jack-rabbits in the West; others have learned to climb and live arboreal lives in the tree-tops; and still other members of this group have become burrowers and live in dens underground like some of our native rats and mice.

From the instances mentioned above it is evident that the mammalian organism is very plastic and has been molded

XUM

by the environment to which it has been subjected during the ages. The larger effects evidenced by profound modifications in the anatomy are the result of continued pressure extending far back in time. The far more numerous, modern, and superficial changes known to naturalists as geographic variations are everywhere in evidence.

By the collection of great series of specimens in North America and elsewhere in the world it has been proved that it is common for a single species of mammal to occupy a great area, including such diverse climatic conditions as humid forested districts near the sea-level, sections of arid desert plains in the interior, and high rugged mountain slopes. In each area of differing conditions it is ordinarily found that representatives of a species, under certain conditions, vary from those in other areas mainly in shades of color and in proportions.

GEOGRAPHY AND COLOR

In arid areas the colors are usually distinctly paler and grayer, in the humid districts they are darker and browner. Other conditions also effect these changes among members of the same species, as is shown in some of the most arid and desert plains of the southwestern United States, where mammals living among dark-colored lava beds are darker than those found, sometimes within a few rods, on paler adjoining soil. Complete isolation under the same climatic and other conditions sometimes produces marked changes, as is well illustrated by the difference between the Abert and Kaibab squirrels on the two sides of the Grand Canyon in Arizona (see page 448).

The different forms of a species occupying areas under varying conditions are commonly termed geographic races. They grade imperceptibly into one another along the border between their ranges, step by step with the gradations of the climatic and other conditions which have produced their differences.

ANIMAL CHEMISTS CHANGE STARCH INTO WATER

One of the most striking modifications of mammalian economy by environment is that shown in many small mammals of our southwestern desert region and adjacent parts of Mexico, in which such species as the kangaroo-rats, pocket-mice, prairie-dogs, and others are able to exist under the most arid conditions without drinking. The liquid necessary for supplying their bodily needs is obtained through chemical action in their digestive tracts, whereby some of the starchy parts of their food are changed into water.

Over considerable areas in the waterless deserts on the peninsula of Lower California periods of from three to five years sometimes pass without a drop of rain falling. In these areas the small desert mammals named above, as well as wood-rats, white-footed mice, cottontails, and jack-rabbits, are numerous and successfully pass these dry periods without inconvenience. The absolute independence of water of these animals has been demonstrated in southern California in the case of pocket-mice kept for months in captivity in a box and fed solely upon thoroughly dried seeds without their showing the slightest sign of discomfort.

Our small mammals may be roughly classified by their food habits into three main groups: Rodents, or gnawing animals; carnivores, or flesh eaters, and insectivores, or insect eaters.

GNAWERS MOST NUMEROUS OF MAMMALS

The rodents vastly outnumber all other mammals and are typified by the squirrels, rats, and mice; their food is mainly vegetable matter, but many of them eat insects and meat whenever available. The carnivores, including such species as the weasel, mink, and marten, are mainly flesh eaters, preying largely upon rodents, but they also eat insects and fruits of many kinds. The insectivores include the moles and shrews, which, with all the bats found within our limits, are almost exclusively eaters of worms and insects.

While rodents primarily feed on vegetable matter, it is surprising to note the large number of species among them which commonly feed on insects and have strong carnivorous propensities. This is not so much the case with such larger rodents as the beaver, porcupine, and woodchuck, but most of the smaller kinds,

Photograph by Howard Taylor Middleton

A MILLENNIAL SCENE: A RABBIT-HOUND AND A YOUNG RABBIT ENJOYING EACH OTHER'S SOCIETY

Here the camera records a friendship almost as remarkable as that which is to mark the association of the lion and the lamb in the final days of the world's history

from squirrels to mice, have been found to be confirmed flesh eaters.

The destruction of the eggs and young of birds, both on the ground and in the trees, by these animals must have a far-reaching effect in reducing the number of insectivorous and other small birds. Some small rodents, as the grasshopper-mice, subsist mainly upon insects and flesh.

The naturalist who sets traps for small rodents in field or forest is constantly annoyed by finding trapped animals partly devoured by their fellows. When mice or rats are confined together in cages and provided with an abundance of vegetable food, it is a common experience to find that the stronger kill and eat the weaker ones, until in a short time only a single survivor remains. These cannibalistic traits are strongly developed in the common house rat, which is notorious for its savagery toward others of its kind.

CASES OF CONCENTRATED FEROCITY

To a certain extent the ferocity of mammals appears to increase in proportion to a decrease in their size. The smaller members of the weasel family—the weasels—are relatively far more active and bloodthirsty than the minks, martens, and other larger members of the group.

If the common weasel should be increased to the bulk of a mountain-lion and retain its nature and physical prowess, it would be many times more dangerous than any existing carnivore and the devastations it would commit would be appalling. Even the tiny insect-eating shrews are endowed with a fierce and aggressive spirit scarcely equaled among larger animals.

Rodents and insectivorous mammals are without effective weapons of offense or defense against the birds and beasts

Photograph by Howard Taylor Middleton

A WEASEL AT BAY ON A TREE-TRUNK

Wolves, coyotes, and foxes are the natural enemies of this ferocious little creature. In spite of its diminutive size, it is a foe to be respected, for its attack is always aimed at a vital point—commonly the brain, the back of the neck, or the jugular vein of its adversary.

of prey which beset them. Many, however, are surprisingly courageous when brought to bay, and, using their front teeth, will fight to the death with vigor and spirit. This is especially notable of the muskrats and their cousins, the field-mice. Carnivores, both great and small, have teeth and claws with which to defend themselves against attack.

WHY THE SKUNK NEVER HURRIES

In addition, skunks have an even more potent weapon in the secretion of a vile-smelling liquid which is sprayed on a dangerous enemy. So confident are skunks in the efficacy of this weapon that they are extremely calm and unhurried in their manners and take little trouble to avoid an encounter with man or beast. Their odorous weapon is not used among themselves and appears to be held for service against more dangerous enemies.

Scent glands are common among rodents, carnivores, and insectivores, but are ordinarily used for purposes of communication with others of their kind, sometimes to attract the opposite sex and sometimes merely to give notice of their presence in a locality.

The hard school of experience holding through the ages has taught many of our rodents the necessity of lying up stores of food to meet periods of scarcity. Many species store food in a desultory way whenever a surplus is available, but when harvest time comes, at the close of summer, the work is taken up as a serious occupation during many busy hours each day or night by the species living where the severe northern winters make the stores a necessity.

The storage instinct is possessed as well by many of the southern desert species, where climatic conditions permit activity throughout the year. In such regions the supplies serve during storms and in periods of drought, when the yield of plant food is limited.

Photograph by Howard Taylor Middleton

ARMED NEUTRALITY: A DOG AND A SKUNK PREPARE FOR COMBAT

Once in a lifetime the photographer of wild life gets an opportunity such as is recorded here. Luck was with the camera man, but not with the terrier, as a moment after this picture was made the dog was a very nauseated and embarrassed animal, the skunk having employed its natural weapon with overpowering odoriferous effect.

GOOD HOUSEKEEPING IN RODENT LAND

One can but marvel at the wise prescience with which northern rodents gather their winter stores and hide them away safe from the weather in secret places in hollow trees, old logs, crevices among the rocks, or in neat storage chambers dug for the purpose adjoining underground burrows. The size of the stores and the tireless industry of these little husbandmen in gathering them might well serve as examples worthy of emulation by some of their human neighbors. The seeds gathered are freed from chaff, the grasses and herbs are dried as "hay," and roots are carefully cleaned before being stored.

The storing habit appears to be nearly always for purely individual benefit. The food is usually stored in bulk, but squirrels and chipmunks often bury here and there single nuts, which they are able to recover long afterward through their extraordinary powers of smell.

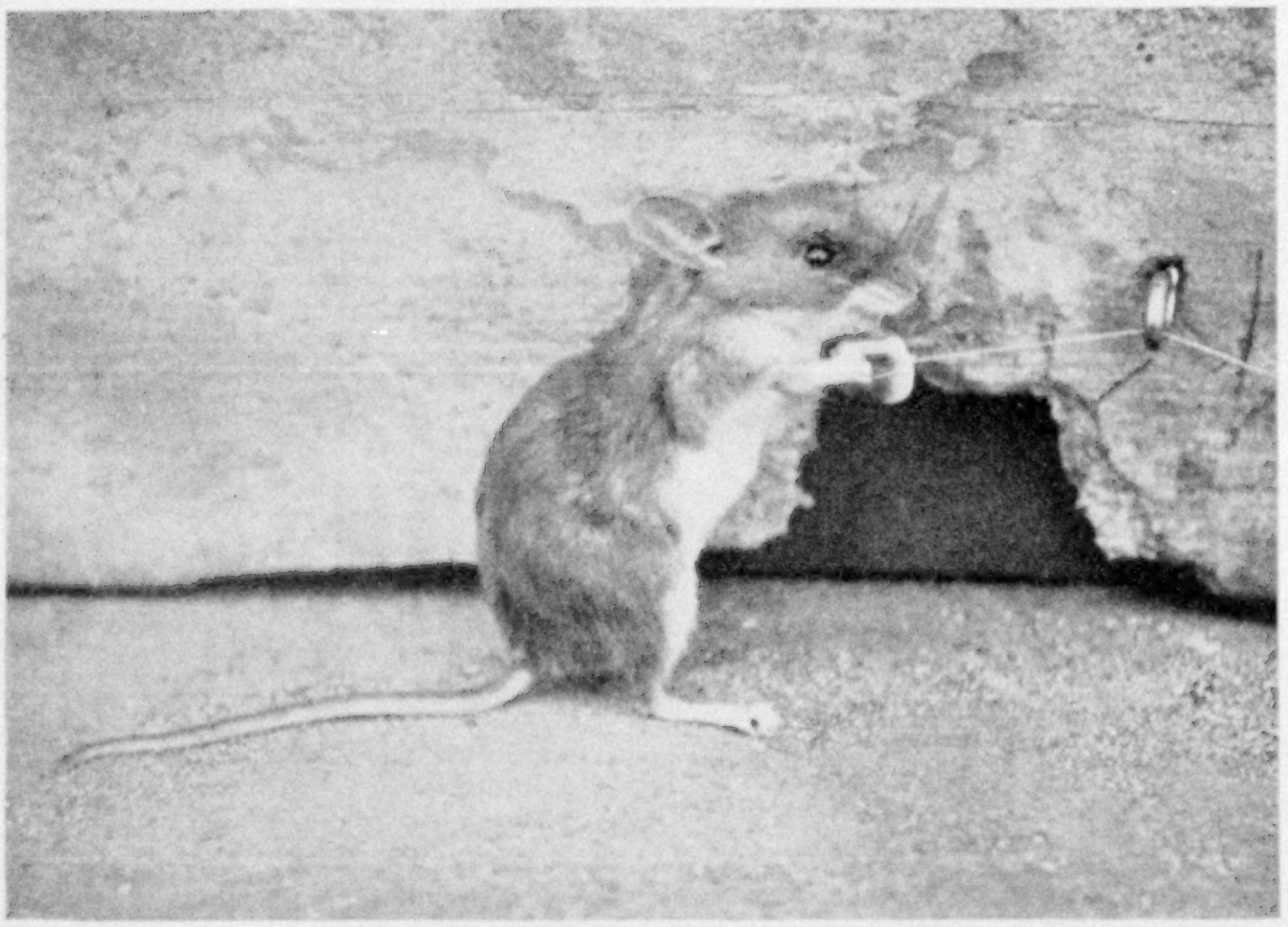
Stores are laid by for a single season, and a single failure of a nut or seed crop will cause the starvation of many small animals, and the failure of the crops for two or more seasons is so disastrous that the rodents may nearly or quite all die of famine over great areas. The reverse of this occurs during successive years of bountiful nut and seed crops.

An abundant food supply appears to be a powerful stimulant to the fecundity of mammals, and the number of young at a birth, as well as the number of litters born during a season, are greatly increased by it, until their haunts fairly swarm with them.

THE EBB AND FLOW OF ANTAGONISTIC SPECIES

With this stimulated increase of rodent life goes a related increase in the number of birds and mammals which prey upon them. The close relationship between the numbers of rodents and of the carnivores which prey upon them is shown by the records of the Hudson Bay Company, in which with the increase or decrease in the abundance of varying-hare skins secured by the fur traders goes a corresponding increase or decrease in the number of lynx skins taken.

After rodents become enormously



Photograph by Howard Taylor Middleton

IT IS NOT VANITY WHICH PROMPTS THIS MOUSE TO TAKE ITS OWN PICTURE

The bait is a grain of corn attached to one end of a thread; the other end operates the camera shutter; but the pose is almost "studied"

abundant, if food becomes scarce they sometimes make extended migrations, during which vast numbers swarm across the country, like the lemmings of the North or the gray squirrels during their historic migrations of early days in the eastern United States. At such times vast numbers of the wandering hordes perish; epidemic disease also plays its part in reducing their numbers. Nature thus is self-limiting in restraining the permanent increase of any species beyond the numbers needed to preserve its balance.

The advent of man in new regions with his clearing of forests, cultivation of the soil, and destruction of animal life for food or other purposes, quickly upsets the balance of nature, and some species are much reduced in numbers or disappear, while others, especially among the smaller kinds of mammals, may greatly benefit through added food supplies, and then increase until they become a pest, to be destroyed by the farmer as a measure of self-protection.

ANIMALS THAT SEEK SAFETY IN DARKNESS

For some reason, perhaps owing to their small size and defenselessness against birds and beasts of prey, the great majority of small mammals, including hundreds of species and untold millions of individuals, are nocturnal or live such obscure and hidden lives they are unknown except to the comparatively few people who go much afield, with all their powers of observation alert by day and by night. Many of the mainly nocturnal species pursue minor activities by day, where shelter of one kind or another gives them a reasonable feeling of security.

Under the revealing light of day most small mammals, especially the rodents, are extremely watchful and timid, leading lives filled with alarms which commonly end in tragic deaths. By night

Photograph by Howard Taylor Middleton

A NEST OF YOUNG WHITE-FOOTED MICE

One form of this small animal has been found living at an elevation of from 15,000 to 16,000 feet on Mt. Orizaba, Mexico, the highest record of any North American mammal

they appear to have far greater confidence; yet this also is a time of imminent danger from the owls and many beasts of prey then prowling about.

That the small rodents have good cause for their timorous ways is plain when we consider the array of enemies which encompass them, including owls, herons, gulls, bears, foxes, bobcats, weasels and their cousins, with snakes, and on occasion fishes, which take endless toll from their numbers. Fortunately for them, these small folk live wholly in the present and quickly forget the shadow of death cast by the passage of a hawk or the skulking form of a four-footed enemy.

COUNTLESS BEASTS THAT ROAM THE NIGHT

By day the squirrels, chipmunks, woodchucks, and spermophiles are abroad and unite with the birds to lend an air of pleasant animation to forest and plain. With the falling shades of night, near the abodes of mankind as well as in the remote wilderness, everywhere a countless multitude of small beasts come forth and form a little, bright-eyed furry world, clad in delicate shades of gray and brown and characterized by remarkable grace and agility.

These small folk of the night swarm out from snug nests hidden in burrows in the earth, in crevices among the rocks, in hollow trees, under logs or other cover, and even from the shelter afforded by buildings. In number and variety of forms they far exceed anything seen by day. The air is filled with the flitting forms of bats, while among the trees or on the ground, varying with the locality, are multitudes of rabbits, flying-squirrels, rats and mice of many kinds, lemmings, pocket-mice, kangaroo-rats, pocket-gophers, shrews, and even moles.

This abundance of night life brings forth the prowling powers of darkness in the form of velvet-winged owls, weasels, skunks, minks, martens, and other carnivores, which by scent and by keen vision find abundant harvest. The small carnivores, in turn, are subject to the preda-

XUM

Photograph by George Shiras, 3rd

A MINK TAKING ITS OWN PICTURE BY FLASHLIGHT

This is one of many remarkable nature studies which have been made possible by Dr. George Shiras 3rd's invention and development of animal flashlight photography, with the animals themselves as the photographers. The naturalist may have to spend hours, sometimes days, waiting in swamp or desert to study his quarry, but by means of flashlight photographs the inhabitants of the wild are revealed in their native haunts to all who read a story told in pictures. Dr. Shiras's notable contributions to this magazine have always won hearty appreciation from members of the National Geographic Society.

tory law of might and are at times hunted by the larger carnivores, as the great-horned owls, the wolves, foxes, fishers, bobcats, and mountain-lions.

To most people the majority of small rodents are classed as "rats" or "mice" and are viewed with the prejudice born of long familiarity with those omnipresent pests, the house rats and mice. The small beasts of field and forest are commonly of remotest kinship to these repulsive household parasites and are of entirely different lineage, having nothing in common but their size.

ANIMAL INTELLIGENCE AKIN TO MAN'S

When viewed with unbiased attention, these little animals of the wilds are certain to charm the observer either by their beauty and grace or by their varied and interesting habits. No one can long study mammals, large or small, without observing many traits of intelligence so akin to his own that they awaken feelings of friendly fellowship.

The modes of life of small mammals are much more varied than those of the larger species. At times radical differences in habits may be noted among different individuals of the same species, as instanced by the wood-rats of Santa Margarita Island, some of which live in burrows dug by themselves in the ground and others in nests built of sticks in the tops of mangroves rising amid the waters of a lagoon.

An even more extraordinary variation is shown among the heavy-bodied meadow-mice of the genus *Phenacomys*, most of which live in underground burrows; but one member of the group in Oregon builds its nests in the tops of tall

conifers, sometimes at an altitude of 80 feet, and rarely or never descends to the ground.

PEEPS INTO FUR-FOLK HOMES

The homes of small mammals vary greatly. The species living in underground burrows usually excavate an oval chamber which is filled with fine vegetable material to form a snug retreat. The muskrat places a conical lodge on the border of a marshy stream or lake. The wood-rat lives in an underground burrow, in a nest of sticks and trash heaped above the ground or in a stick nest placed among the branches of low trees. Harvest mice build a little hollow ball of grass blades, lined with finer material, among the branches of bushes several feet above the ground. White-footed mice may lodge in a knot-hole 50 feet or more above ground in the trunk of a tree.

As a rule, small mammals are of inconspicuous colors which harmonize so well with their surroundings that when not in motion, especially if lying close to the ground, they are difficult to distinguish. Exceptions to this rule are obvious in the case of jack-rabbits when standing on bare plains, or other mammals which are apart from the usual partly concealing growth of vegetation or other surroundings.

In contrast to the protective coloration are certain markings, like the cottony white underside of the tail of the cottontail rabbit, which renders the flight of this animal conspicuous in the gloomiest shades of the forest, or even on the approach of night, when it is impossible to distinguish the animal itself. The white underside of the tail of the antelope chipmunk is another well-defined instance of this kind.

NEW COATS FOR BOREAS' COURT

The most marked of all examples of "directive" coloration among the small mammals appears to be that of certain white-sided jack-rabbits, in which the white areas on the sides and rump are drawn up and down as the animal runs across the plains, giving a flashing effect, which attracts attention to them exactly as does the white rump-patch of the antelope.

In the northern part of the continent, where snow lies for many months, several species of hares are dusky or buffy gray in summer and change to a pure white coat in winter. This change is of enormous protective value to these animals. In Greenland, where the summer is short and snow exists throughout the year, the highest northern representative of the hares remains permanently white, while near the southern border of snow in the United States the varying hares and white-tailed jack-rabbits, which become pure white in the northern parts of their range, make only a partial change.

Weasels are the only carnivores which change from the brown of summer to a white winter coat. Owing to their small size and the need for activity in the snowy northern regions, where they would be peculiarly susceptible to danger from birds of prey and larger predatory animals, their protective white coats serve them well.

It was formerly considered that the change of mammals from the brown of summer to the white winter coat in the fall, and from the white to the brown in spring, was due to a change in the color of the hairs, but it is now known that it is entirely due to molt. The time of these changes depends on the season, and this varies several weeks, according to whether the fall or spring is early or late.

The general shades of mammals are of delicate tints, and the spots, stripes, and other markings, as in the case of chipmunks and the little spotted skunk, are often of great beauty.

ANIMALS THAT HAVE TO SING

Small mammals vary greatly in their vocal powers, but the changes in intonation and character of the notes and calls indicate plainly that they are used to convey a variety of meanings.

Some are practically voiceless, as in the case of rabbits and hares, except when in an extremity of fear they utter loud shrieks of terror. Squirrels, prairie-dogs, and some other small mammals bark and chatter, while mice and bats have a variety of curious squeaking notes. Marmots and ground-squirrels have chattering notes and sharp, whistling calls.

In addition, some of the squirrels and

XUM

many mice are known to have continuous series of notes which are as evidently songs as the utterances of birds. Some of these notes, as in the case of singing mice, have a remarkably musical character, similar to the warblings of canaries. Various unrelated species of mice have been observed singing, and a closer study of the life habits of these small animals may develop the fact that all are songsters to some degree.

House rats and mice have, undoubtedly, been parasitic about the haunts of man from early times. From Asia they have accompanied him through his advance in civilization. With the growth of commerce they have traveled around the world, becoming transplanted to all lands and thriving in all climates. In various parts of America they have not only become pests about human habitations, but where climatic conditions were favorable have reverted to the wild state and are competing with the native species in the fields.

Of all the small mammals none have become modified to such an extent as the bats. As a group these mammals are of world-wide distribution except in the inhospitable polar regions. They are true mammals and present an extraordinary variation in size, from tiny little creatures, almost as small and fragile as butterflies, to the huge fruit-bats, with a spread of wings like that of a wild goose.

BATS WITH BULLDOG FACES

The heads of bats are strangely sculptured, some being smoothly contoured and shaped like those of little foxes; others appear like miniature bulldogs; and still others have curious cartilaginous nose-leaves upright on the muzzle. Some have the entire face molded into a hideous mask repulsive to look upon.

Their habits are equally varied to meet special conditions: Some are eaters of fruit alone; others feed solely upon insects, while others bite other mammals, including man, for the purpose of drinking the oozing blood, upon which they subsist. All are nocturnal, but some appear late in the afternoon, before the sun sets; most species, however, wait until the shades of night have covered the earth.

Throughout the world the majority of the species of bats feed upon insects, but there are many fruit-eaters. The teeming insects and plant life of the tropics afford a never-failing food supply, and the center of abundance of these animals is found there. In some localities between twenty and thirty kinds of bats exist, with such vast numbers of individuals that the bat population far outnumbers all other kinds of mammals combined.

ANIMALS THAT PUT THEMSELVES IN COLD STORAGE

In the northern parts of the Old and New Worlds many mammals, including bears, marmots, prairie-dogs, ground-squirrels, and jumping mice, pass a large part of the winter months in a lethargic sleep called hibernation. While hibernating these animals have extremely slow and slight heart action and their bodily temperature falls far below the normal of their active periods. During the most profound hibernation an animal may be awakened if brought into a warm temperature, but when again put into the cold at once returns to sleep.

Preparatory to this sleep, during the summer and in the autumn, the hibernating mammals become exceedingly fat.

It has long been generally accepted that the fat thus accumulated was for the purpose of being gradually absorbed to nourish the animals during their long fast. As a matter of fact, during this period the bodily functions appear to be practically suspended and the animals may be said to be in cold storage. This is evident from the fact that observations have been made of ground-squirrels, and even bears, emerging in spring, after their long winter sleep, practically as fat as when they retired in fall. Hibernating animals become extremely active as soon as they come out in spring and quickly lose the fat which should be of special service to them, owing to the temporary shortage of food they experience at this season.

Most hibernating species do not retire for the winter until cold weather is at hand, in September or October, at times remaining out until after the first snow has fallen. The animals which retire

XUM

latest, like chipmunks and prairie-dogs, sometimes appear temporarily during certain warm periods in winter.

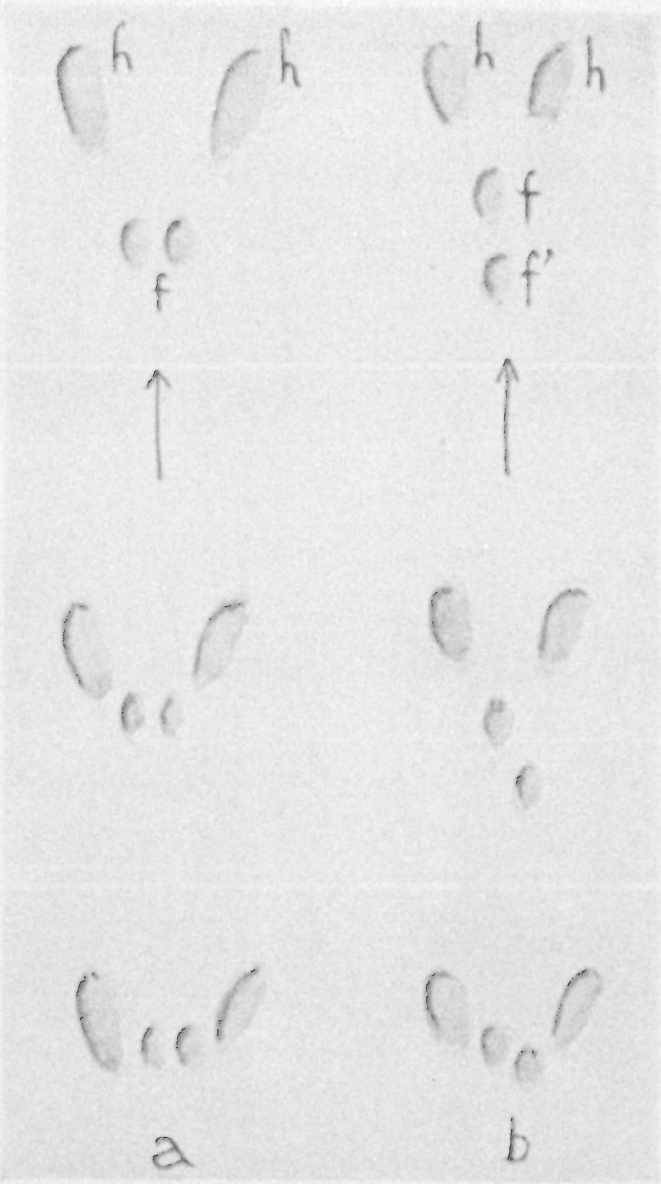
Recent observations have established the fact that the adults of both sexes of the Richardson ground-squirrel living in the Northwestern States and adjacent parts of Canada become excessively fat by the first of July, and before the first of August practically disappear for the season, not appearing again until they emerge the following March or April. The retirement of these squirrels for a part of the summer is a case of imperfect estivation, as it is termed, followed by complete hibernation. The young of the year enter hibernation at a considerably later date.

DEFENSIVE AND OFFENSIVE ANIMAL ALLIANCES

A great number of both large and small mammals live solitary lives except for brief periods during the mating season or the association of the young with the mother. Some species, however, like the wolves and coyotes, may mate permanently and show great mutual affection and constancy. Many species have well-developed social instincts, which appear in some cases to combine two purposes, self-defense and the desire for companionship.

Herds of large herbivorous mammals, such as musk-oxen and buffalo, frequently present a solid array of bristling horns to the attacking wolves, and thus protect the weaker members of the herd and give an example of the usefulness to them of the social instinct. Wolves and some other predatory animals hunt in couples or in packs and succeed in pulling down prey which singly they could not successfully attack.

Prairie-dogs living in colonies have the advantage of community intercourse as well as added safety through the chance that some member of the colony will espy an approaching enemy and by its warning cry allow a safe retreat. In other cases, such as the flying-squirrels, which gather in considerable numbers in hollow trees or other shelter, and the bats, which gather in caves, the congregation appears to be purely from a desire for close companionship.



FOOTPRINTS OF NATURE'S WILD FOLK

BY ERNEST THOMPSON SETON

In the drawings accompanying Mr. Nelson's article I usually give the track of a normal adult animal in about one inch of snow, that being ideal for tracking. Some of the smaller kinds are shown in fine dust. The trail goes up or across the page at the ordinary gait of the animal. The scale is indicated, but when possible the topmost set is given of life size. While there are endless variants in each kind, I aim to give the reader at least one typical set of each.

In all animals which bound, the hind feet track ahead of the front ones. This is very plainly seen in the rabbits. There are two arrangements of the fore feet when bounding: That of the rabbit (*b*), in which the fore feet are usually one behind the other, and that of the tree-squirrel (*a*), in which the fore feet are side by side. The latter arrangement is associated with power to climb a tree. The former means that the animal is purely terrestrial. These, however, are true only as generalizations. There are exceptions in all species. The ground-squirrels conform to the rabbit type. The tracks are, of course, ideal, giving far more detail than is usually to be seen.

XUM

THE ANTELOPE JACK RABBIT (Lepus alleni and its relatives)

(*For illustration, see page 404*)

The antelope, or Allen, jack rabbit is one of the most picturesque of American mammals. It is larger than the common western jack rabbit and is strongly characterized by enormous ears, long, slender legs, short tail, and contrasting colors. It is a member of the white-sided group of jack rabbits, which are distinguished by the extension of the white of the underparts well up on the sides of the body.

This group is represented in limited areas on our southern border by two species. One of these, the Gailliard jack rabbit (*Lepus gailliardi*), occurs on the grassy plains of extreme southwestern New Mexico and is succeeded by other white-sided species southward across the Mexican tableland and through interior Oaxaca to the Pacific coast, on the Isthmus of Tehuantepec. The other species, the antelope jack rabbit, occupies a considerable area in southwestern Arizona, and with its geographic races ranges southward through the coastal plains of Sonora and Sinaloa to northern Tepic.

All jack rabbits are more or less closely related to the Old World hares, the term "rabbit" having been so generally misapplied to them by the early settlers in the western United States that the name is now fixed by current usage. In Mexico and among the Mexicans of our southwestern border the proper distinction is made and the jack rabbit is termed *liebre*, or hare, and cottontail is called *conejo*, or rabbit.

The white-sided species are more widely differentiated from their Old World relatives than the other jack rabbits and are the southernmost representatives of the true hares in America, reaching their limit in the tropics a little beyond the Isthmus of Tehuantepec.

The extension of the white on the sides of these species assists in producing one of the most extraordinary examples of directive coloration known among mammals. I had the pleasure of discovering this one day in May, 1895, when hunting on horseback over the grassy plain bordering the Pacific coast of the Isthmus of Tehuantepec. As I rode slowly along, a big jack rabbit hopped deliberately from its form in the grass a few yards away, and by the contraction of a special set of muscles along the back drew the dark-colored dorsal area forward and together so that it formed only a narrow band on the middle of the back, with a corresponding extension of the white area on the rump and sides until, as the animal moved diagonally away, it looked almost entirely white.

At a distance of fifty or sixty yards it came to a stop, and expanded and contracted the dark dorsal area, thus producing a "flashing" effect with the changing area of white on the sides and rump. This solved the riddle of the mirror-like white flashes I had often seen as jack rabbits on the tableland had dashed away in the brilliant sunshine. The same habit of "flashing" the white was afterwards observed in the species of southwestern New Mexico and southwestern Arizona, demonstrating the appropriateness of the name, "antelope jack rabbit," given them by the ranchmen.

Formerly the antelope jack rabbit of Arizona was common on the plains about Tucson, where many were shot for rifle practice. They are now comparatively scarce in that district, and are never so excessively abundant as the common species of the West now and then becomes. They have an extraordinary appearance as, with their great ears erect, they stand poised on their long, thin legs. When alarmed, they leap away with amazing celerity in long, high bounds. They are usually much more shy and alert than the common jack rabbits and at times are far more difficult to stalk than antelope. A peculiarly appropriate setting to this remarkable species is found in the strange and wonderful growth of giant cactuses, yuccas, creosote bushes, fouquerias, palo verde, and other desert vegetation of the plains in Arizona and Sonora.

Like other hares, the antelope jack rabbits occupy forms under bushes or in the shelter of little patches of coarse vegetation. The only exception to this rule I have seen was west of the city of Guadalajara, on the Mexican tableland. There one summer day, in the midst of a lovely open valley covered with short, velvety green grass and dotted with scattered acacia bushes, a caracara eagle suddenly swooped down upon a young white-sided jack rabbit. In mortal terror the little beast dashed away at great speed, the caracara casting at it repeatedly from a height of fifteen or twenty feet and each time striking the ground just behind. The young animal ran not less than five hundred yards, straight for a little bush on a small bank, where it vanished as by magic.

The caracara was close behind and, alighting, ran round and round the trunk of the bush, craning its neck and apparently as surprised as myself at this sudden disappearance. Riding over to investigate, I found, partly concealed by coarse grass, the entrance of a burrow large enough to admit an adult jack rabbit. It extended almost horizontally into the bank for about eighteen inches, and then, turning abruptly to the left, ended in a rounded chamber some fifteen inches in diameter, in which the young jack rabbit lay snugly ensconced. It appeared altogether probable that this burrow had been made by the old jack rabbit as a shelter for her young, one of which in its extreme need had again sought asylum there.

White-sided jack rabbits are frequently found in pairs, occupying forms in close proximity to one another. More rarely several may be found in a small area. When driven from the forms, they often run in a wide circle, and in the course of half an hour or more may be detected returning slyly and watchfully from a direction nearly opposite to that in which they departed.

XUM

THE CALIFORNIA JACK RABBIT

(Lepus californicus and its subspecies)

(For illustration, see page 405)

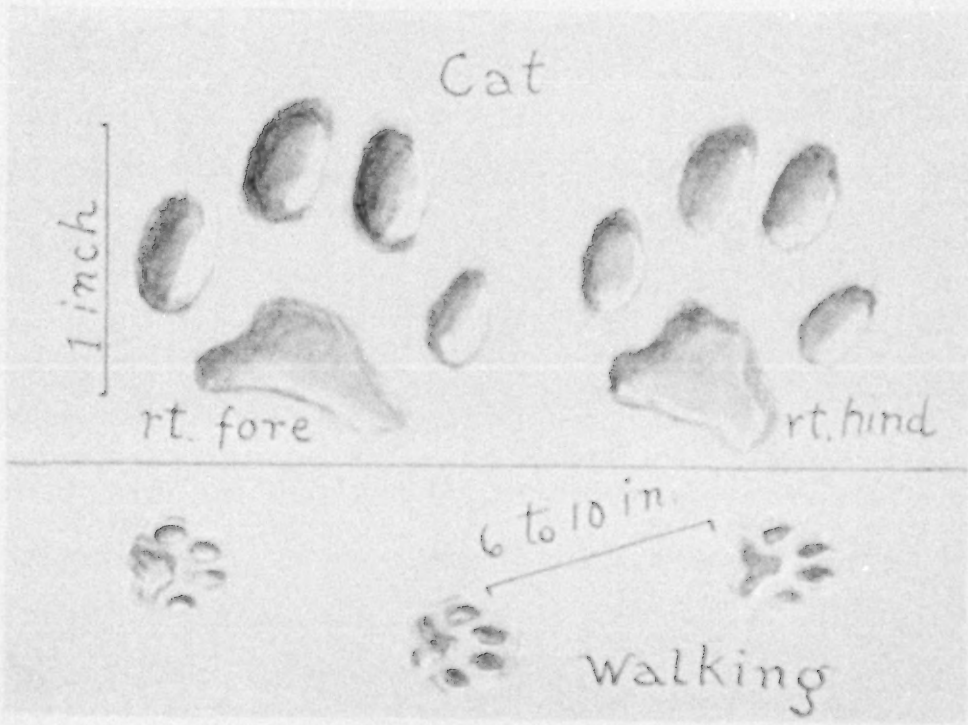
The common hares, or gray-sided "jack rabbits" of the Western States, are among our best known and most interesting mammals. They are characterized by long, thin necks, long ears tipped with black, long legs, grayish sides differing but little from the color of the back, and a rather long tail, black on its upper side and dingy gray below.

They are abundant and generally distributed over a vast and mainly treeless area in middle North America extending from western Missouri and eastern Texas to the Pacific coast, and from the border of South Dakota and the Columbia River Valley of Washington south over the tableland of Mexico and throughout the peninsula of Lower California. Within this region they range from sea level up to an altitude of over 9,000 feet. In the North they experience severe winters with much snow, but never show any winter whitening of their furry coat, as do more northern hares.

The gray-sided hares over all this extended range belong to a single species, typified by the California jack rabbit. The area thus occupied includes many different climatic and other physical conditions, from the sweeping grassy plains of Kansas to the juniper and pine dotted plateaus of the Rocky Mountain region, the foggy coast of California, the hot cactus-grown deserts of the Southwest, and the cool elevations of the Mexican tableland.

This varying environment has worked on the plastic organization of the species and modified it into a considerable number of well-marked geographic races which together make up the gray-sided group of jack rabbits, in contrast with the white-sided group already described. Some of the races are very dissimilar in color, but each merges imperceptibly into its neighboring races, and the group thus forms an unbroken chain of subspecies.

Like other hares, the jack rabbits are both diurnal and nocturnal in habits. They do not burrow, but make forms among dense growths of grass or weeds, or under bushes, where they lie hidden. It is a question whether they have more than one litter a season, although it is known that in some parts of their range young are born at all times throughout the spring and summer. From one to six are produced at a time, fully clothed in fur and with their eyes open. Within a few days they leave the "form" and run about like little furry balls. Even at this early period they are amazingly alert and skillful in evading capture by quickly doubling and zigzagging when pursued.



A QUADRUPED WITH BIPED TRACK: THE COMMON CAT

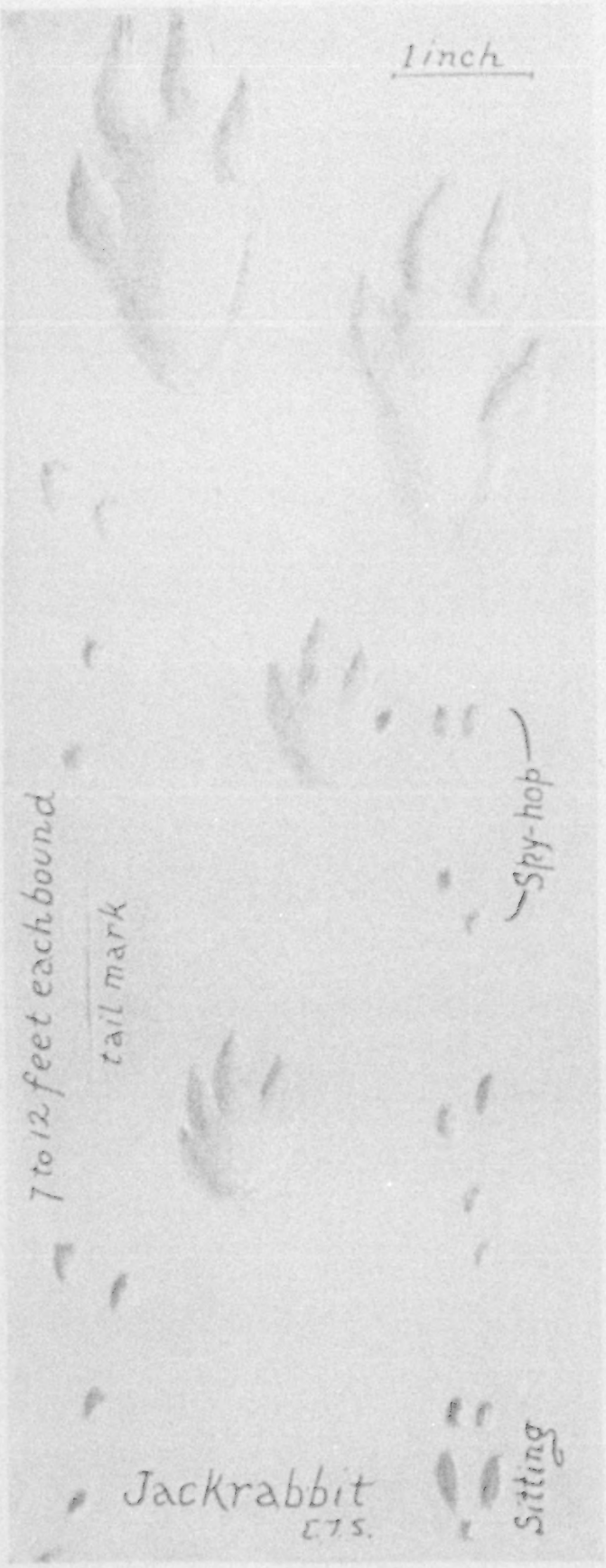
The cat does not show its claws in the track. In walking, the hind foot is set exactly in the track of the front foot; this perfect register offers many advantages and makes for a silent tread. The track of the cat will probably be noticed more than that of any other animal, owing to the large numbers of them in every locality.

Throughout its range the gray-sided jack rabbit is preyed upon by a host of enemies, including wolves, coyotes, wildcats, eagles, and several species of hawks and owls. As a result it has become extremely cunning and watchful. It is a beautiful sight to observe the cautious grace with which one that suspects danger but thinks itself unobserved will quietly move out of its form, pause like a statue for a few seconds, then raise its body into a sitting posture and look keenly about, its great upstanding ears turning sensitively to one side and the other, delicately testing the air for sound waves, which may spell approaching peril.

If not alarmed it may then move slowly along by a series of easy little hops, occasionally varied by the single-footed gait of most other mammals. At such times the ears are often raised and lowered as though worked by some mechanism. If the rabbit becomes alarmed, however, it leaps away in quick, springy and graceful bounds, now and then making a high soaring leap as if to command a better view.

These occasional high leaps mark the first stages of alarm. In greater stress, when pursued by a coyote or other swift-footed enemy, the jack rabbit indulges in no such showy performances, but gets down to serious work, and

XUM



THE TRACKS OF THE JACK RABBIT

The tracks of the western jack rabbit resemble those of the cottontail (see page 390), but the feet are seldom paired; a typical set is seen in the lower left-hand corner. The bounds cover 10, 12, or even 15 feet each. The tail is held down, so that it leaves a mark in the snow between each bound. Sometimes the animal makes a spy-hop—that is, hops up high to look around. This is seen in the track.

developing marvelous action in a continuous series of rapid, low stretching leaps, with ears lying flat along the shoulders, it skims over the ground almost as swiftly as a bird. Coursing jack rabbits with greyhounds was for many years a favorite sport in different parts of the West. No other dog has much chance for success in the open pursuit of these animals.

Ordinarily jack rabbits are mute, but when wounded and caught they not infrequently utter a series of long-drawn wailing shrieks which are movingly expressive of terror and pain.

Since the settlement of the Western States numberless predatory animals have been killed and at the same time the cultivation of the soil has produced a dependable increase in the food supply. These changes have resulted in the sporadic increase of jack rabbits in many parts of their range, from Texas to Oregon, until at times they have become a serious menace to agriculture.

During such periods of abundance they invade fields and devastate grain, forage crops, vineyards, and young orchards. In places they sometimes actually destroy entire crops and force settlers to abandon their locations. In winter they swarm about haystacks and destroy many tons of hay. Depredations of this character were committed by them on a considerable scale during 1916 in parts of Oregon, Idaho, and Utah.

During the early development of the San Joaquin Valley, California, jack rabbits became such an intolerable pest that great community drives were organized. Large woven wire corrals with wing fences leading away several miles from the entrance were built on the open plains. The occasions of the drives were made public holidays through all the surrounding region, and people gathered sometimes to the number of from 5,000 to 8,000. A great line of beaters was formed, miles in length, and the jack rabbits were driven between wing fences into corrals. Four such drives in Fresno County in the spring of 1892 resulted in the destruction of 40,000 jack rabbits, one drive netting more than 20,000 animals.

At this time the level floor of the San Joaquin Valley was crossed by numberless well-worn rabbit trails six or eight inches broad and one or two inches deep, extending in long straight lines sometimes for miles. On approaching a patch of large weeds one often saw twenty or thirty jack rabbits dash out and, after hopping away a short distance, sit with upstanding ears to look curiously at the intruder.

It is a general rule that when any species of animal becomes extremely numerous it loses its ordinary wariness and, conversely, when its numbers are materially reduced its wariness is greatly increased. The periods of abundance of jack rabbits usually extend through several years until, at the height of their increase, a contagious malady suddenly sweeps them away almost to the point of extinction, as in the case of the varying hare. A period of years follows during which their numbers are slowly recovered.

Jack rabbits are specially adapted for life on great plains, where speed and the ability to subsist on almost any form of vegetation are prime qualities. They are as grotesquely characteristic of the Western States as the kangaroos were of Australia, and have entered largely into the literature of the region they occupy.

THE VARYING HARES (Lepus americanus and its relatives)

(*For illustration, see page 405*)

The varying hares, white rabbits, or snowshoe rabbits, as they are known, form a small group of closely related species and geographic races of hares peculiar to northern North America. They sometimes attain a weight of five pounds and are about half the size of the arctic hares, which they resemble in form, except that they are more heavily built and have proportionately shorter legs and larger hind feet.

With a single exception they become white in winter and change to dusky or brownish in summer. The molt from the brown summer coat to the white winter one occurs with the arrival of winter snows, the exact time varying according to the season, the reverse change in spring being governed in a similar way by the disappearance of the snow. In the southern part of their range the change to the white winter coat is less complete than in the North. There has been much controversy over the manner of this change in color, some maintaining that on the approach of winter the hairs turn white with the first snow. It has been definitely proved, however, that both seasonal changes are due to molt.

The Washington hare (*Lepus washingtoni*), which remains brown throughout the year, is the exception to the rule of white winter coats in this group of hares. It lives in the cool, dense forests of the humid coast belt of Washington and adjacent part of British Columbia, where the snowfall does not affect its pelage.

In winter the large hind feet of the varying hares and their long, spreading toes are entirely covered with a heavy coat of hair, forming broad snowshoe-like pads, which enable their possessors to move about freely over the soft snow, a peculiarity that has given rise to one of the names in common use.

In cool, forested regions varying hares range from Maine and extreme eastern Canada, including Newfoundland, to the Pacific coast, and from the stunted bushes bordering the northern limit of trees south to the northern border of the United States and beyond, following the higher Alleghenies to West Virginia, the Rocky Mountains to New Mexico, and well down the Sierra Nevada in California.

As in the case of other species, these hares make "forms" in which they lie by day, for they are mainly nocturnal in habits. The mating season occurs in early spring, when the males become very restless, several sometimes congregating in the same vicinity and occasionally fighting and chasing one another about. At this time, as well as at other seasons, snowshoe rabbits have a habit of thumping rapidly on the ground, making a dull sound audible for some distance. This is probably done with the hind feet, as is known to be the case with the European rabbit.

The thumping is apparently a signal and may be a part of the mating display, but is also used for warning purposes. Hunters in northern Canada call these rabbits by making a harsh squeaking noise with their lips. Sometimes they become so eager and excited on hearing this call that with odd little grunting sounds they come bounding close up to the hunter.

The young, varying from two to seven, are born in nests made of dry leaves, grasses, and other suitable vegetation, warmly lined with hair from the mother's body, and usually hidden under brush or in dense vegetation. The young, which have their eyes open and are fully furred at birth, within a few days leave the nest and move freely about. Although the mother snowshoe rabbit will defend her young at first even at the risk of her life, when they are half grown she leaves them to shift for themselves. Young hares of various ages when caught often utter shrill squealing cries of fright and the older animals when wounded and caught sometimes do the same.

Perhaps through living so constantly in low ground, among swamps and along streams, varying hares become less averse to entering water than most of their kind. In the delta of the Yukon River I saw many places where they had crossed small streams in spring, their wet tracks entering and leaving the water, thus furnishing unmistakable evidence. Curiously enough, when caught by a flood they will take refuge on stumps or other support and often remain to starve rather than swim ashore.

In summer, owing to their nocturnal habits and the dense thickets they inhabit, varying hares are rarely seen unless they are unusually plentiful. In winter their presence is known by their conspicuous tracks, leading in every direction through their haunts. A single animal will in one night so thoroughly track the snow in a patch of woods it gives the impression that several must have been there.

In river bottoms, among densely wooded swamps, these rabbits frequently make definite beaten runways in the snow; runways are also made through thickets in their summer haunts. This habit renders it easy to snare them, and enormous numbers are thus captured every winter.

They feed on a variety of small herbage in summer and in winter depend on buds, twigs, and the bark of shrubs and small trees. They are specially fond of willows, and their winter distribution in many districts is governed by the abundance of willow thickets.

Varying hares are one of the most important mammals of the northern fur country. They are generally distributed and exist in such num-

XUM

FOOTPRINTS OF THE VARYING HARE, OR SNOWSHOE RABBIT

The great size of the feet from which the creature is named is a strong feature of the track, distinguishing it from that of the cottontail and others (see pages 387 and 405)

bers that they are an important source of food supply both to the Indians and to such predatory birds and mammals as the great horned and snowy owls, the goshawk, gyrfalcon, lynx, fox, ermine, fisher, and others. The skins are also used by the Indians for robes.

Under favorable conditions they steadily increase until they become enormously plentiful over great areas. After this swarming abundance continues for several seasons it reaches a maximum, and then, as in the case of many other mammals when similarly overabundant, a mysterious malady suddenly attacks and sweeps them off, until within a year or two they become rare over the entire area. The people of the fur country believe these changes in

numbers run in cycles of about seven years each.

As the hares increase in numbers some of the birds and mammals which prey upon them increase proportionately. This is specially marked with the big northern lynxes. The skins of varying hares are gathered and sent to the London fur market with other furs, including those of lynxes. In the records of sales of the Hudson's Bay Company there are direct increases of the numbers of Canada lynx skins sold corresponding with the increases in the sales of varying hare skins. As the number of hare skins abruptly decreases following the outbreak of epidemics among them, there are correspondingly abrupt decreases in the numbers of lynx skins sold.

This correlation is shown in the records extending back many years and illustrates the interdependence in nature between the various forms of animal life. The far-reaching tragic effect of the sudden disappearance of the snowshoe rabbits is not confined to the wild habitants of the forest, as it has not infrequently brought starvation and death into many lonely Indian lodges in the great northern wilderness.

THE ARCTIC HARE (Lepus arcticus and its relatives)

(*For illustration, see page 408*)

Many parts of the northernmost circumpolar lands are occupied by large hares, which attain a weight of more than ten pounds. They are about the size of large jack rabbits, but are more heavily proportioned, with much shorter ears and shorter, stronger legs. There are several species and geographic races of these animals, all of which are snowy white in winter except for a small black tip on each ear. In summer the southern arctic hares change to a nearly uniform dull iron gray or grayish brown. The northernmost animals of Ellesmere Land and north Greenland, where the summer is brief and severe arctic conditions prevail, retain their white coat throughout the year.

In keeping with the cold climate of their territory, the furry coat of the arctic hares is long and thick, especially in winter, when the ears, legs, and even the soles of the feet, as well as the body, are heavily furred. The coats of the hares of north Greenland and adjacent region are so heavy and fleecelike that during the spring molt they come off in felted patches as the new coat is assumed, giving the hares a curiously ragged appearance.

In the region between the areas in which the summer coat remains wholly white and where it is completely changed to grayish, there is a gradual transition, with the lessening severity of the climate, through every intermediate degree between the two. As in the case of the snowshoe rabbit, the large hind feet and long spreading toes of its big northern relative are so heavily covered with hair that they form broad fluffy pads, which enable the hares to travel lightly over the arctic snowfields.

The distribution of arctic hares is confined to the barrens or tundras beyond the limit of trees. They range practically to the land's end of northern Greenland and Ellesmere Land To the southward in North America they range down the coast of Labrador and across to Newfoundland, where they are limited to the open barrens. They also occur along the shores of Hudson Bay and follow the tundras bordering Bering Sea to the peninsula of Alaska.

In Ellesmere Land they are reported to be extraordinarily numerous at times in certain little valleys, and the fur traders on the coast south of the Yukon Delta informed me of similar gatherings in spring on gently sloping hillsides in that region. Photographs taken in Ellesmere Land show many of these hares scattered over a small area, each crouched in a compact form and all heading in the same direction to face the wind. Such gatherings, at least those in Alaska, occur during the mating period, after which the animals scatter over the area they occupy.

An account of the big northern hares would be incomplete without reference to the white-tailed jack rabbit, the largest of all American hares and a near relative of the arctic species. It attains a weight of twelve pounds or more and appears like a giant of its kind. It has longer legs than the arctic hare and a longer tail. In summer it is grayish or buffy, with a conspicuous pure white tail. Throughout most of its range in winter it becomes pure white except the black tips to the ears, but near the southern border the change to white is not so complete as in the North. The distribution of the white-tailed jack rabbit extends from Minnesota to the Cascade Mountains and from the Saskatchewan River, in Alberta, south to southern Colorado.

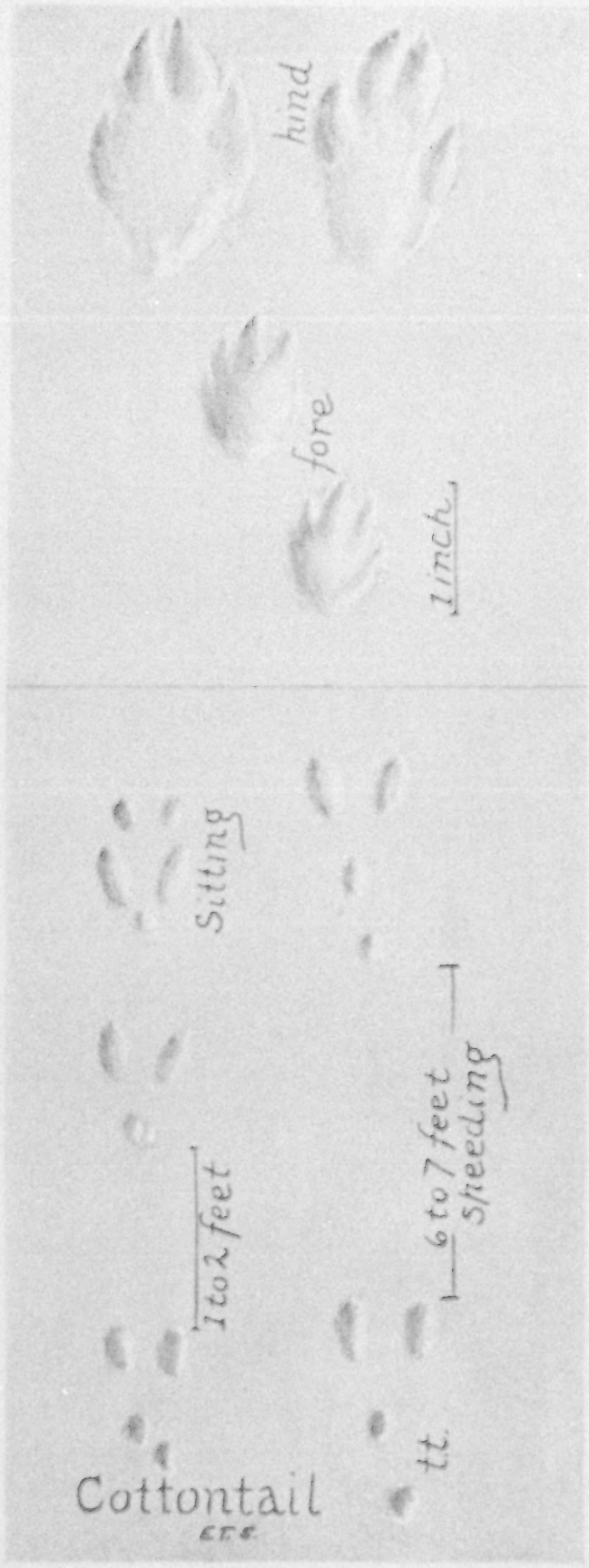
Arctic hares have from one to seven young in a litter each spring. Owing to the climatic conditions under which they exist, it is doubtful if more than a single litter is born each year.

The manner in which animal life adapts itself to its environment is beautifully illustrated by the arctic hares of north Greenland and Ellesmere Land. There the conditions are rigorously arctic and continuous winter night extends through a period of several months. In all this region the scanty and dwarfed vegetation is covered with snow and ice the larger part of the year. The hares living there are, with little question, a geographic race of those living farther south, but have developed into larger and stronger animals, with heavier fur, to meet the sterner conditions of life.

Their claws are much larger and heavier, so that they may dig the snow from the hidden herbage. Most marvelous of all, the anterior ends of both jaws are lengthened and the incisors set so that they project and meet at an acute angle, thus serving, tweezerlike, more readily to pick out the lowly vegetation imbedded in the snow.

In most parts of their range arctic hares are scarce and rarely encountered. Each winter during my residence on the coast of Bering

XUM



THE COTTONTAIL RABBIT'S TRACK

The large set of four tracks at the top gives the maximum possible of detail, which is very rarely seen. The lower figure at the right-hand corner is a typical track (*tt*). At the set marked "sitting" the tail mark is seen, and in this only are the fore-feet tracks ahead of the hind tracks. The cottontail has five toes on the front feet, but only four ever show in the track (see page 408).

Sea the Eskimos killed only a few individuals. They were shy and watchful and the hunters sometimes followed one on snowshoes all day over the tundra without securing it. In the high North they appear to be more numerous in places, judging from the number killed for food by members of polar expeditions. Their flesh is excellent, but a little dry. Their natural enemies include wolves, foxes, weasels, gyrfalcons, and snowy owls, all of which share their desolate haunts and join in destroying them.

The winter skins of arctic hares have a beautiful snowy white pelage, which make warm garments and sleeping robes for the North, but are too delicate to withstand much service.

THE COTTONTAIL RABBITS (Sylvilagus floridanus and its relatives)

(*For illustration, see page 408*)

North America has several species of hares, but no typical representative of the European rabbit. The American cottontails and their near relatives, the brush rabbits and others, combine characteristics of both the hares and rabbits, but are most like the rabbits, of which they appear to form aberrant groups.

The cottontails are distinctly smaller than most of the American hares and average from two to three pounds in weight. They are otherwise contrasted with the hares by their short ears, proportionately shorter and smaller legs and feet, and by the fluffy snow-white underside of the tail, which shows so conspicuously as they run that it has given them their distinctive name.

The American mammals to which the term "rabbit" may be properly applied include not only the cottontails, but numerous other species closely similar in form and general appearance, but lacking the cottony white tail. As a group, these rabbits have a far greater distribution in America than the hares. They range from the Atlantic coast to the Pacific and from the southern border of Canada south through Central and South America to Argentina. Their vertical distribution extends from sea level to above timberline, attaining an altitude of more than 14,000 feet on Mount Orizaba, Mexico.

In the United States cottontails are so numerous and generally distributed that they are well known to nearly every one. They inhabit all kinds of country, from the deciduous forests of the Eastern States to the grassy or brush-grown plains and pine-clad mountain slopes of the West and the sun-scorched deserts of the Southwest. As a result of this extended distribution and the variety of conditions in the areas occupied, these rabbits include numerous species and geographic races, which in some instances differ greatly in appearance.

Cottontails are especially common about the brushy borders of cultivated lands throughout the country, and in fertile brush-grown areas of foothills, valleys, and river bottoms of the

West. They are mainly nocturnal, and in areas where there is an abundance of natural cover in the way of brushy thickets and dense grass commonly make concealed "forms" in which they lie safely hidden.

In areas where shelter is represented by scattered bushes and a comparatively thin growth of other vegetation they generally occupy burrows in the ground. These may be holes deserted by badgers or prairie-dogs or dug by themselves under a rock or other object. Hollow logs or natural cavities and crevices among the rocks are also frequented. When pursued by dogs, hares as a rule rely solely on their speed for safety, while the cottontails take refuge in the first hole they can reach.

Everywhere in their territory, as the shades of night approach, the cottontails come forth from their hiding places and skip merrily about in open ground on the borders of thickets and similar shelter, where they search for the tender green vegetation on which they love to feed. After it becomes too dark to distinguish their forms, the white tail may be seen twinkling about in the dusk. During the night they are often revealed in country roads by the head lights of automobiles.

Several litters of from two to six young usually appear during the spring and summer. These are born blind and practically naked, their unclad helplessness strongly contrasting with the open-eyed, fully furred, and alert young of the hares at the same age. This is a conclusive indication of the close relationship between cottontails and European rabbits, the young of the latter being similarly, but even more, undeveloped at birth.

The young of the cottontails are born in nests made of dead grasses warmly lined with fur from the mother's body. If above ground the nest is placed in a little depression and so artfully concealed by a covering of dead grasses that it can be discovered only by accident. When caught, young cottontails utter little cries of alarm; the wounded adults sometimes shriek in terror.

From the early settlement of the United States to the present day cottontails have been so abundant that they have served as a valuable source of our game food supply. They are hunted with guns and with dogs, as well as being snared and trapped. Enormous numbers, running into the millions, are killed in this country yearly, but they are so prolific that they hold their own in a surprising degree.

Their abundance in many places, however, has made them a serious pest to agriculture. They eat growing alfalfa and other forage plants, many kinds of cultivated vegetables, young grape vines, and nursery stock and even kill orchard trees by gnawing the bark from the base of the trunks. As a result those who suffer from their depredations consider them pests to be destroyed, while others look upon them as desirable game animals to be protected by law.

As game animals the cottontails furnish some of the most delightful and interesting sport available to American hunters. The scurrying zigzag rush of a cottontail for the nearest shelter is so full of energetic motion that it always excites a pleasurable thrill in the observer, and even the keenest sportsman has so friendly a feeling for these little animals that the escape of one of them from an unsuccessful shot nearly always leaves a feeling of humorous amusement.

The cottontails have a secure place in American literature and folklore. Who has not read the wonder stories of the adventures of "Brer Rabbit" and ever after had a warmer feeling of fellowship for his kind? The presence of cottontails is a source of pleasure to children of all ages, and their disappearance from the wild life of a locality creates a more deeply felt blank than would the passing of many a nobler animal.

THE MARSH RABBIT (Sylvilagus palustris and its relatives)

(*For illustration, see page 409*)

The marsh rabbit, or "pontoon," as it is known in Georgia, is a distinctively American species allied to the cottontails, but distinguished from them by its more heavily proportioned body, smaller ears, shorter and slenderer legs and feet, and shorter, nearly unicolored tail. Its only close relative in the United States is the swamp rabbit, known in Alabama as the "cane-cutter."

These two species appear to be members of a Tropical American group of which other members are the wood rabbits of Mexico, Central and South America. The distribution of the group was probably at one time continuous, but a change to arid conditions in northeastern Mexico and Texas isolated the two species remaining in this country.

The distribution of the marsh rabbit is limited to the southeastern coastal States from Dismal Swamp, Virginia, to Mobile Bay, Alabama. It is common in suitable places in Florida. Its larger relative, the swamp rabbit, ranges west from this area to Texas and up the Mississippi Valley to Illinois and southeastern Kansas. Swamp rabbits are numerous in the low, wooded coastal region of Louisiana. They are larger and longer-legged than marsh rabbits and fleeter of foot.

Among all the rabbits of the world the marsh and swamp rabbits are the only species which have aquatic habits. Both live mainly in marshes, wooded swamps, and along the low wooded courses of streams. Other rabbits and hares are occasionally known to cross water by swimming, but the marsh and swamp rabbits live about the water and take to it with all the freedom of a muskrat or mink. The marsh rabbit appears to be the more aquatic of the two, as the swamp rabbit sometimes lives in the forest, farther back from the water.

The Tropical wood rabbits are habitants of the dense forests, where they are well hidden under the rank undergrowth. They are not known to enter the water, but, like their northern relatives, make runways through the dense

XUM

vegetation they frequent. The marsh rabbits live in cypress or other fresh-water swamps, heavily wooded bottoms, and fresh water, as well as brackish marshes. They feed on a variety of vegetation growing in such places and dig up such edible roots as the wild potato and amaryllis.

Both marsh and swamp rabbits have several litters of from two to six young each season, beginning in April. The young are born in large, well-made covered nests, which are built of rushes, grasses, and leaves and lined with hair from the parents. The nests, which have an entrance on one side, are usually located in the midst of dense growths of vegetation or on tussocks, in low, swampy places, and are sometimes surrounded by water. In the most frequented parts of marsh and swamp these rabbits make well-trodden trails through the dense vegetation.

When alarmed, marsh rabbits run for the nearest water, into which they plunge and swim quickly to the shelter of aquatic plants or other cover. When cut off from escape by water they try to avoid capture by doubling and turning, but are so short-legged that they are readily overtaken by a dog. The tracks of these rabbits in the mud differ from those of the cottontails in showing imprints of the spreading toes.

In South Carolina Bachman once found numerous marsh rabbits in the thickets about recently flooded rice fields and swamps. When he beat the bushes the rabbits plunged into the water and swam away so rapidly that some escaped from a Newfoundland dog which accompanied him. Several, apparently thinking themselves unnoticed, stopped and remained motionless about fifteen yards from the shore, with only their eyes and noses showing above water. Thus concealed in the muddy water, with ears laid flat on their necks, they were difficult to see. When touched with a stick they appeared unwilling to move until they saw that they were discovered, when they quickly swam away.

Later, when the water subsided to its regular channels, where it was about eight feet deep, many of the rabbits were seen swimming about, meeting and pursuing one another as if in sport. One which Bachman had in captivity during warm weather would lie for hours in a trough partly filled with water, with which the cage was furnished.

THE PIKA, OR CONY (Ochotona princeps and its relatives)

(*For illustration, see page 409*)

The pika, little chief hare, or cony, as it is variously named, is among the most attractive and interesting of our mountain animals. It is about the size and shape of a small guinea-pig, with a short, blunt head, broad, rounded ears, short legs, practically no tail, and a long, fluffy coat of fur. While most nearly related to the hares and rabbits, it has very different habits.

The pikas form a group comprising many species, much alike in general appearance and distributed among the high mountains, from the Urals of Russia through Asia and northern North America. In Asia they occur mainly in the mountains through the middle of the continent south to the Himalayas. In Pleistocene time they ranged across Europe to England. In North America they are limited to the western side of the continent, from the Mount McKinley region of Alaska down the Rocky Mountains to New Mexico and along the Cascades and Sierra Nevada to the Mount Whitney region, in California.

Giving to these North American animals the appellation "cony" is one of many instances in which the name of an Old World animal is brought to America to designate a totally unrelated species. Once fixed in current use, the misapplied term is certain to persist.

Pikas are among the few mammals which live permanently along the high crests of the mountains, mainly above timberline, but they also descend in rock slides among the upper spruces, firs, and pines. The altitude of their haunts varies with the latitude, being between 8,000 and 13,500 feet in the United States, but in Alaska much lower.

In these cool, alpine regions the little animals live wholly within the shelter of rock slides and among the crevices of shattered rock masses. Their distribution is unaccountably broken, and although abundant in many places, they are absent from many others equally suitable. Their homes are in the midst of the flower-bedecked glacial valleys and basins, the haunts of the big marmots and mountain sheep.

They are mainly diurnal in habits, and throughout the day may be heard their odd little barking, or bleating note, like the syllables "eh-eh" repeated at intervals in a nasal tone, resembling the sound made by squeezing a toy dog. Occasionally they may be heard barking at night, perhaps when disturbed by some prowling enemy. Their notes have a curiously ventriloquial quality, which renders it difficult to locate the animals uttering them.

Owing to their dull gray or brownish colors, the pikas blend with their background so completely that when quietly sitting on a rock they are extremely difficult to see. Even when running about at a little distance they are not easily noted. Their movements are quick and they scamper over the rough surface of a rock slide with surprising agility.

Little is known of their more intimate life history. Their young, three or four in number, are born usually during the first half of summer and are out foraging when less than half-grown.

Small, bright eyes and big, rounded ears give pikas an odd and attractive appearance, unlike that of any other mountain animal. They are extremely watchful and at the first alarm disappear in the shelter of their rocky fortresses. Their little bark, however, continues to come up from their hiding places with constant iteration. If the observer will sit quietly at some good vantage point his patience will eventually

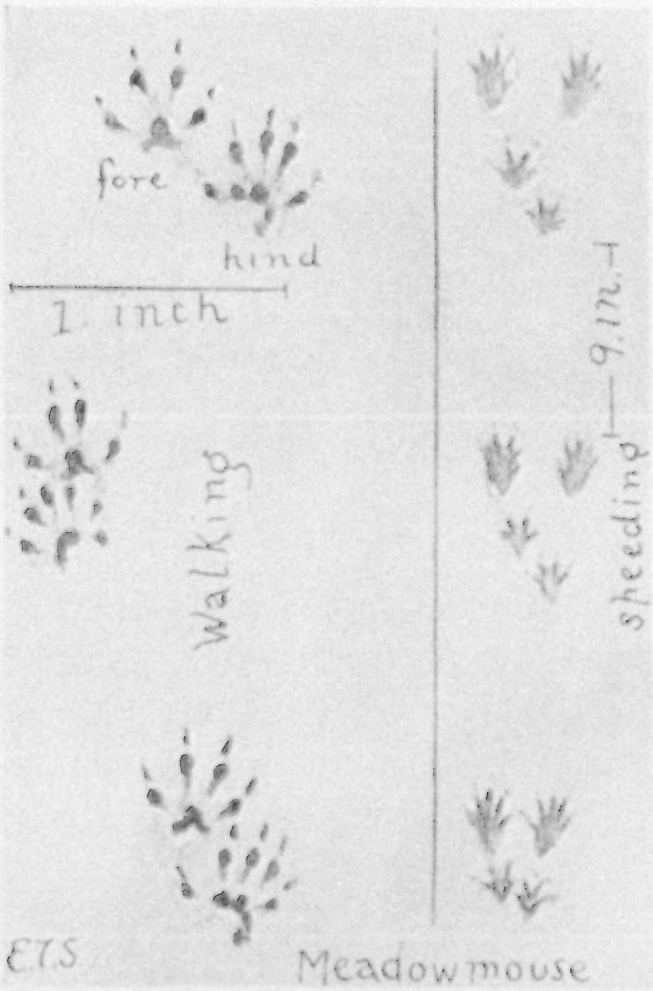
XUM

be rewarded by the appearance of the pika on the top of a stone near the mouth of its retreat.

After a time, if everything is quiet, it resumes its scampering about over the rocks or may come to the border of the slide and make little excursions across the open ground after some of its forage plants. Skipping nimbly from the border of the slides to neighboring patches of vegetation, sometimes fifty or more feet away, the pika nips off the stems of short grasses or other plants and taking them up, like small bundles, crosswise in its mouth, runs back to add them to its "stacks." These sallies are quick little runs, made as though in fear of being long away from the safety of the rocks. Caution is needful, however, in a world where lurk such enemies as coyotes, lynxes, foxes, weasels, hawks, and owls.

During late summer the pikas have the extraordinary habit of gathering stores of small herbage in piles containing sometimes a bushel each, usually well sheltered in dry places under the rocks where they live. Pikas are active all winter, and these little stacks of well-cured hay, containing a great variety of small plants, serve them as food during the severe cold season, when at these high altitudes they are buried under many feet of snow.

In pleasant weather, near the end of summer, visitors to the mountains of Colorado, Glacier National Park, the high slopes of Mount Shasta, or of the Sierra Nevada may have the pleasure of watching the pikas hard at work doing their "haying." One of their "stacks" in the mountains of New Mexico contained thirty-four kinds of plants, including many flowers. No one who once becomes acquainted with these unique and gentle little animals will ever cease to remember them with friendly interest.



THE TRAIL OF A FIELD OR MEADOW MOUSE

When compared with that of the deermouse, one notes the absence of the tail mark and the rarity of the fore feet being paired (see pages 403 and 420).

THE PORCUPINE (Erethizon dorsatum and its relatives)

(*For illustration, see page 412*)

The porcupine is one of the most grotesque of the smaller North American mammals. With a weight of from fifteen to twenty pounds, its heavy body is supported on short legs, the feet resting flat on the ground like those of the raccoon, instead of on the toes, as in most small animals.

Its strongest peculiarity is the specialized development of most of the fur into rigid, sharp-pointed spines or "quills" from half an inch to over three inches in length. That the spines represent the underfur of ordinary mammals is evident from the fact that they are overlaid by long, coarse guard hairs, sometimes several times their length.

The spiny armament usually lies flat on the body, but when the animal is excited or alarmed it may be raised, by special muscles on the underside of the skin, into a bristling array of barbed points. The spines are so slightly attached that when their points enter the skin of an enemy they at once become free at the base. The points firmly set in the skin of another animal, the spines can be withdrawn only with considerable effort, and if left will gradually work deeper and may traverse a considerable part of the victim's body before finally becoming encysted.

When assailed the porcupine turns down its head, arches its back, and, on firmly planted feet with all its spines erected into a bristling cover, awaits the enemy. The instant its body is touched the club-shaped tail, armed with a multitude of spines, is swung vigorously around and the animal so incautious as to receive the blow is pierced by a host of stinging darts which, freed from the porcupine, remain to torment the aggressor. This swift and effective sweep of the tail has probably given rise to the idea that the porcupine can "shoot" its quills when defending itself.

Despite its defensive powers, however, the porcupine is, on occasion, successfully attacked by various enemies, including the mountain lion, bobcat, fisher, and even the eagle and great horned owl. The fisher is said habitually to kill and feed upon them, and the encysted quills are commonly found under its skin.

The frightful effect of an ill-judged attack on a porcupine is shown by inexperienced dogs

after their first encounter with this strange beast. That such an attack is a dangerous venture, even by the craftiest and most powerful of its enemies, is well demonstrated by occasional fatalities among large carnivores which result from the great mass of spines imbedded in their heads and bodies.

The North American porcupine is a northern animal belonging mainly to coniferous forests, and ranges from sea level to timberline. It originally occupied nearly all the forested parts of the continent south to West Virginia, southern Illinois, the Davis Mountains of western Texas, and the southern end of the Sierra Nevada in California, but was absent from the Southeastern States and the lower Mississippi Valley.

While characteristically a woodland animal, at times it wanders from forest shelters and has been found prowling about above timberline on high mountains, and among alder thickets beyond the limit of trees in the far North. They are usually silent, but at times utter a curious squealing cry, and in addition have a variety of snuffing, growling, and chattering noises.

In the forests of tropical America, from Mexico to Brazil, other and shorter-quilled porcupines occur, characterized by smaller size and slenderer bodies with a long tail, the terminal half of which is naked and prehensile like that of an opossum. These animals inhabit forests where no conifers grow, and are much more arboreal in habits than their northern relatives. Still other and even more strikingly different porcupines occur in Europe, Asia, and Africa, some of the African animals having heavy spines more than twelve inches long.

All porcupines are true rodents, and the name hedgehog is erroneously used when applied to any of them. Hedgehogs are small Old World insect-eating mammals, which have their backs covered with porcupine-like spines, but are in no way related to the porcupines.

The American porcupines are mainly nocturnal, although they sometimes wander about by day. While largely arboreal in habits, they pass much of their time on the ground and commonly have their dens in caves at the bases of cliffs, under the shelter of large rocks, logs, piles of brush, or in hollows at the bases of trees. They are sluggish, stupid animals, with poor sight, and are unable to move rapidly, either in a tree or on the ground.

Although on the ground they are extremely deliberate, in the treetops they are even more sluggish and can be compared only with the sloth. In consequence they are practically helpless in the presence of an enemy except for the defense afforded by their spiny armor. That in most cases this is effective is evidenced by their continued presence throughout a large part of their original range where forests still exist.

Porcupines are solitary animals, totally devoid of any qualities of good fellowship with their kind, but the attraction of woodland camps often brings a number together. They are exceedingly fond of salt and persistently return to camps to gnaw logs, boards, or any other object having a salty flavor.

They appear to be practically omnivorous so far as vegetable matter is concerned and feed upon the bark and twigs of spruces, hemlocks, several species of pines, cottonwoods, alders, and other trees and bushes. In orchards and gardens near their haunts they eat apples, turnips, and other fruits and vegetables and visit the shores of ponds for waterlily pads and other aquatic plants growing within reach.

Ordinarily they eat patches of bark from the tree trunks, but sometimes girdle the tree or at times denude the entire trunk. They often remain for weeks in the top of a single tree, even in the severest winter weather. I had a practical illustration of this on one occasion when stormbound in a fur trader's cabin at the head of Norton Bay, on the north coast of Bering Sea, where a belt of spruces reached down from the interior. We were short of meat, and when one of the Eskimos reported that some time before he had seen a porcupine in a spruce tree he was sent to look for it. A few hours later he returned bringing the game, having found it in the very same tree where he had seen it many days before, although we had just experienced a period of severe weather, with temperatures well under 40 degrees Fahrenheit below zero. It was on this occasion that I first learned the palatable qualities of porcupine flesh.

Little is known definitely concerning the family life of these animals. The young, from one to four in number, are amazingly large at birth and appear fully armed with spines. Even before they are half grown they adopt the solitary habit of the adults and wander forth to care for themselves.

Porcupines have an intimate connection with the romantic side of early Indian life in eastern America. Their white quills were colored in bright hues by vegetable dyes known to the Indians and served to make beautiful embroidery on belts, moccasins, and other articles of aboriginal clothing until primitive art gave way to the more tawdry effects of trade goods.

THE JUMPING MOUSE (Zapus hudsonius and its relatives)

(*For illustration, see page 412*)

In several ways the jumping mouse is unique among American mammals. Its strongest characteristics are a dull, rusty yellowish color, a slender body about three inches long, a remarkably slender tail about five inches in length, and long hind legs and feet, which are specially developed for jumping, like those of a little kangaroo. In addition it is provided with cheek pouches, one on each side of the mouth, in which it gathers food to be carried to its hidden stores.

The long tail serves as a balance during its extraordinary leaps, some of which in a single bound cover a distance of about ten feet. If by accident one of these animals loses its tail,

XUM

whenever it jumps it is thrown into a series of somersaults, turning helplessly over and over in the air.

The jumping mice form a small group of species and geographic races closely similar in general appearance. They are the sole representatives in North America of the Old World jerboas and are themselves represented elsewhere by a single species occurring in the interior of China. The jerboa family contains in addition many larger and curiously diverse species distributed over a large part of Asia, Africa, and southern Europe. Many Old World jerboas are desert animals, some of them exact reproductions in shape and color of the kangaroo rats of arid regions in the Western and Southwestern States and Mexico, although they are in no way related to those animals.

Jumping mice are distributed over most of the northern parts of North America from the Atlantic coast of Labrador to the Bering Sea coast of Alaska, and southward to North Carolina, Illinois, New Mexico, and California. They are nocturnal in habits and live in or near the borders of forests, in thickets of weeds or brushwood, and in meadows adjoining woodland areas or forest lakes. In prairie country they occupy belts of woody growth bordering streams. In congenial locations they range from sea level up to an altitude of 8,000 feet or more.

For winter homes they dig burrows two or three feet deep, in the lower parts of which they excavate oval chambers and fill them with fine grass and other soft material to make a warm nest. Other chambers opening from these burrows serve as store-rooms for berries, seeds, and nuts of various kinds, among which beechnuts are a favorite.

The nests occupied as summer homes are placed in shallow burrows a few inches below the surface of the ground, or they may be in a hollow tree, under a piece of bark, in a dense tussock of grass, or in other makeshift shelter. In these nests the young, varying from two to eight in number, are born at varying times between May and September, indicating the probability that more than one litter is produced each season.

When suddenly startled from her nest the female often flees with several of the young clinging to her teats. She runs swiftly through the grass, and if hard pressed will take a long leap, still carrying the pendant young. It is surprising that such delicately formed animals can make long leaps in thickly grown places and apparently land safely, especially when carrying their young. In the flights of the mother some of the young must be jarred loose, but when the alarm is over no doubt she returns to find and rescue any that may be missing.

In the northeastern States jumping mice are common habitants of meadows. They are equally at home in the rocky meadows of New England, on the flower-spangled borders of rushing trout streams in the Sierra Nevada of California, and the boggy glades of subarctic Alaska.

My first acquaintance with them was made many years ago, during haying time, in northern New York. Hidden under a haycock, as the last forkful was raised one of them was often revealed, and its startling leaps always resulted in an exciting chase, which usually ended in the escape of the strange little beast.

Unlike most of their small fellows of meadow and thicket, jumping mice regularly hibernate, occupying the nests near the bottoms of the winter burrows. They usually become fat on the abundance of food at the end of summer, and in September or October, with the approach of cool weather, enter their winter quarters and sink into the long, hibernating lethargy. Sometimes two of them are found hibernating in the same nest.

During hibernation they are coiled up in little furry balls, the nose resting on the abdomen, the hind feet on each side of the head, and the tail wound around the body. The winter sleep usually lasts until spring, but may be broken at any time by mild weather.

When hibernating the mice appear cold and lifeless, but if one is carried into a warm house or even held a long time in the captor's hands it will slowly awaken and may become as lively as in summer. When returned to a low temperature, however, it soon resumes its mysterious seasonal sleep.

THE SILKY POCKET MICE (Perognathus flavus and its relatives)

(*For illustration, see page 413*)

Soft, shining fur, delicate coloring, and graceful form distinguish the silky pocket mice from others of their kind. The family of which they are members consists of rodents peculiar to America and includes many other species of pocket mice and kangaroo rats. All are provided with little pouches on each side of the mouth for gathering and carrying food, have proportionately long tails, and hind legs and feet more or less developed for jumping. Only in the most remote way, however, are they related to the jumping mice of the jerboa family.

The silky pocket mice vary in size from the tiny yellow species pictured on the accompanying plate, which weighs much less than an ounce, to forms considerably larger than the common house mouse. The little yellow pocket mouse is one of the smallest mammals in the world, and in addition is one of the most beautiful of our small species. Its bright eyes and the delicacy of its form and color, combined with the readiness with which, in most instances, it appears to lose all fear when caught and gently handled, render it extremely attractive.

As with the majority of other pocket mice, the silky-haired species are limited to the more arid parts of North America, and range from the Great Plains west of the Mississippi Valley to the eastern base of the Cascades, to the Sierra Nevada, and farther southward to the Pacific coast, and from the Canadian border to the Valley of Mexico. Vertically, the range

of these mice extends from sea level to an altitude of more than 7,000 feet.

As with the majority of our wild mammals, little accurate information is available concerning their life history. They are habitants mainly of desert regions, where they prefer the areas of sandy loam, which produce an abundance of scattered desert vegetation. They are nocturnal and by day are seen only when driven from their nests. Their rather shallow burrows are made in soft soil, the situation varying a little with the species. Some species burrow only under the shelter of bushes or other vegetation; others out in the bare ground.

Each burrow commonly has grouped in a small area several entrance holes, which lead through tunnels to the central passageway, the nest, and the storage chambers. Usually there is a little pile of loose dirt thrown out on one side of a hole, or a group of holes may be in a little mound of earth. The entrances are usually stopped from within by loose earth, and if a person quietly thrusts in a short stick so as to remove the earthy plug and let in the light he may see the dirt suddenly returned to its place in little jets, as the occupant promptly kicks the door closed again.

The young, varying from two to six in a litter, are born in these little dens in warm nests of dried grasses. They have been found at all times between April and September, thus making it apparent that several litters are produced each season.

The silky, as well as the other kinds of desert pocket mice, do not drink water, and, as has been shown by experiments, they may be kept for months in thoroughly dry sand and fed on dried seeds without any resulting discomfort. Through the long pressure of desert environment they have developed the power to produce sufficient water for their physiological processes by chemical changes in the starch in their food, which are effected in the digestive tract.

Representatives of this group of mice are almost everywhere in the arid parts of their range, and in many sandy localities are extremely numerous and active at night, as shown by the multitude of little tracks in the dust at sunrise each morning. Their presence in the desert is indicated also by the many little conical pits half an inch or an inch deep, where they have located small seeds and dug them up.

They lie close in their burrows during cold or stormy weather, depending on their stores for food, but are not known to hibernate, although in the northern part of their range they are confined to their burrows for long periods.

At one of my camps in the desert of Lower California I found the silky and other pocket mice excessively numerous and so short of food that they swarmed about us at night with amazing lack of fear. My experiences with them are given in the accompanying account of the spiny pocket mice.

The silky and other pocket mice have many enemies, among the worst of which are the handsome little desert fox and the coyote. Others which continually prey upon them are the badger, skunk, and bobcat, as well as many owls.

THE SPINY POCKET MICE (Perognathus hispidus and its relatives)

(*For illustration, see page 413*)

Pocket mice are divided into several natural groups of species, all having certain characters in common, as a pointed head, lengthened hind feet and legs, and external cheek pouches for carrying food. The spiny group contains numerous species, the smallest of which is about the size of a house mouse and the largest nearly twice that size.

They are more slenderly built than the silky species and have longer tails, with the hairs lengthened along the terminal half, thus giving a slightly brushy or tufted appearance. Their most striking character is the distinctly coarser hair with long scattered guard hairs, like small bristles, which conspicuously overlie the fur on the hinder parts of the body and from which the common name is derived.

The distribution of the spiny forms, although nearly the same as that of the silky ones, is a little more restricted. All belong to the arid or desert parts of the West and Southwest, from South Dakota and middle California southward to Michoacan, near the southern end of the Mexican tableland, and throughout Lower California.

Some species inhabit the scattered growth of plants in sandy areas, but they are more generally characteristic of harder and more rock-strewn soil, rocky mesas, and foothill slopes. There a few species make burrows in open ground, sometimes with a single hole, but most of them make their nests under rocks, in crevices, or in burrows sheltered by such desert bushes as Covillea, Bursera, Olneya, Cercidium, and mesquites.

In these shelters pocket mice make little mounds a few inches high and ten or fifteen inches across. The mounds have several entrances on different sides, one of which generally shows signs of recent use, although by day it is kept closed from within by loose earth. Each of the many-entranced dens is occupied by a single animal. Early in the morning, before the wind fills them with dust, tiny trails are to be seen leading from these doorways toward the nearest feeding grounds and all about their haunts.

The spiny and the silky pocket mice, sharing much the same arid region, have the same food plants and are preyed upon by the same enemies. The food of these mice consists mainly of small seeds, including the wild morning glory, wild sunflowers, wild parsnips, and a multitude of others characteristic of the various areas they occupy.

Pocket mice are strictly nocturnal or crepuscular in habits and appear by day only when disturbed. If the plugged entrance to a burrow is opened, however, it will probably be quickly stopped up again from within by the annoyed householder.

XUM

The young, in litters of from two to eight, are born at irregular times according to the latitude and general weather conditions. In the south at least several litters appear to be born each year, the young being noted almost every month.

When camping alone for a few days in the desert near San Ignacio, in the middle of the peninsula of Lower California, I had a unique opportunity to learn something of the peculiarities of the various pocket mice. Three species were abundantly represented, including both the silky and the spiny kinds. They quickly learned that good hunting could be found in and about the tents for the rice grains and other scattered food and promptly took advantage of it.

As soon as approaching darkness began to render objects indistinct, from their burrows among the surrounding bushes they swarmed into camp and were busy throughout the night minutely searching the ground under the shelter tent for every particle of food. In order to see these interesting visitors to better advantage I placed a candle on a small box in the middle of the tent.

Five or six individuals, representing three species, often came within the circle of light at the same time. At first all were shy and when I made any sudden movement would leap in every direction, like grasshoppers, and quickly vanish. The smallest of the species, a member of the silky group, was the shyest of all and remained timid and reserved.

The two larger species, representing both the spiny and the silky groups, were much more bold and quickly became confiding and delightfully friendly. Their attention was promptly attracted to rolled oats which I scattered on the ground in a spot well lighted by the candle.

Sitting quietly close by the bait where the visitors congregated I soon had evidence that among themselves these little beasts are extremely pugnacious. The first to reach the food would fiercely charge the next comer and always try to leap upon its back, at the same time delivering a vicious downward kick with its strong hind feet. Occasionally the newcomer would charge the one already at the food.

When five or six were trying to secure sole possession of the small food pile there was lively skirmishing about the premises, as they alternately attacked and pursued one another over the sand and among the boxes and other camp gear scattered about. Amazingly quick in movements, they would leap now forward, now sidewise, now straight up a foot or more in the air, with almost equal celerity; and the direction of their movements when attacked was often unexpected. When running about on the level sand they had a steady, swiftly gliding motion, which their tracks showed was the result of a series of little jumps.

Both the spiny and the silky pocket mice became so confiding the first night that when I put my hand on the ground palm up with a little rolled oats in it the nearest pocket mouse would run to it, stop for an instant to smell the finger-tips, and then mount and sit quietly on the palm and fill its cheek pouches.

At such times the mice showed no uneasiness, even when raised in my hand to within a few inches of my eyes in order that I might observe their movements more closely. The motions of their front feet when putting food into the pouches were so rapid that it was impossible to follow them. The nose was held just over the food pile, and the cheek pouches would slowly but visibly swell as they were filled until they stood out like little bladders on each side of the head.

As soon as they were full the mice became uneasy to get away and would run from one side of my hand to the other peering down the abysmal depth of three feet to the ground without daring to leap. As soon as my hand was lowered to the ground the mouse darted away to carry the food to its store in the bushes twenty to thirty yards away, quickly to return with empty pouches.

The mice soon became so tame that while they were on my hand or on the ground I could with one finger of the other hand stroke gently the tops of their heads and backs and even pick them up by their tails and suspend them head down. When thus held they remained motionless, their tiny front feet like little closed hands held against their breasts. When lowered and released they would immediately resume the filling of their pouches as though nothing had happened. Several individuals of the dozen or more which made free of the tent had lost part of their tails, so that they could be readily distinguished.

One of these little bobtails was so gentle and confiding that I became much attached to it. It would permit all manner of familiar treatment, such as being picked up by one foot or by the tail, or being turned on its back. With this confidence came a sense of proprietorship in the good things here so suddenly and mysteriously plentiful, as was shown by his attitude toward his fellows.

Again and again when he was filling his pouches from a pile of rolled oats in my hand I lowered it in a gently sloping position within ten or fifteen inches of another mouse gathering food on the ground. Thereupon the little bobtail in my hand would invariably leave the task of filling his pouches and without hesitation leap down on the back of the one on the ground. The surprised animal thus assailed from an unexpected quarter always fled in terror.

After a short pursuit the bobtailed one would come running back and instead of going to the equally inviting pile of food on the ground would come straight to my hand and complete his task. The industry of the little animals appeared to be tireless, as working swiftly they made trip after trip with pouchloads of food to their stores and quickly returned. One night I watched this strenuous work for two hours until I retired.

The abundance and boldness of pocket mice and kangaroo rats at this place led me to believe that there had been a former abundance

XUM

Photograph by Howard Taylor Middleton

YOUNG RED SQUIRRELS AND THEIR NEST

These cute little chaps were found cozily at rest in their nest in a pine. They were routed out, however, long enough to have their portraits taken. An effort was made to include the mother, but without success (see page 454).

of their food here, resulting in a large increase in the rodent population, but that it was then becoming scarce through a failure of rain to renew the seed harvest. The invariable outcome in such cases is for the small rodents dependent on seeds and fruits to be reduced by famine until they become rare, where previously they existed in great numbers. This is one of Nature's processes whereby the danger of the overwhelming increase of any species is automatically prevented.

THE POCKET GOPHERS (Geomys bursarius and its relatives)

(*For illustration, see page 413*)

With the exception of the moles no other extensive group of American land mammals is so highly specialized for a peculiarly restricted mode of life as the pocket gophers. They form a strongly marked family, the Geomyidæ, which includes various genera and many species, all very similar in external form, but varying from the size of a large mouse to a massively formed animal equalling a large house rat in weight.

Without exception they are powerfully built for their size, the head and front half of the body being extraordinarily muscled to meet the demands of their mode of life. The broad blunt head is joined almost directly on the body. The eyes are small and have the restricted vision to be expected from animals living underground. The ears are reduced to little fleshy rims about the openings, and the short naked tail is provided with nerves, which render it useful as an organ of touch.

The front teeth are broad, cutting chisels, and on each side of the mouth is a large pocket in the skin used for gathering and carrying food. On the front feet are long claws, which, when not being used to dig or handle earth, are doubled under, against the soles of the feet, so that the gopher walks on the back of them much as the anteater walks on its folded claws.

Peculiar to North America, pocket gophers occupy a great area extending from Illinois, Florida, and the Gulf of Mexico to the Pacific coast, and from the plains of the Saskatchewan, in Canada, southward to Panama. Their vertical range within these limits extends from sea level to timber-line, at above 13,000 feet on some of the high volcanoes of Mexico. The family attains its greatest development in that wonderful region of plains and volcanoes lying about the southern end of the Mexican tableland.

In the United States these animals are best known as "gophers," but in the range they occupy in the Southeastern States they are called "salamanders" and in Mexico are widely known as "tuzas." As a rule they frequent treeless areas, but are found also in many

types of forests from among the palms and other trees of the tropical lowlands to the oaks, pines, and firs on the mountain sides.

All members of the family live wholly underground, in many-branched horizontal tunnels, which they are continually extending in winding and erratic courses about their haunts. The tunnels are from two to about five inches in diameter, according to the size of the animal, and while usually less than six inches below the surface, the approaches to the nest and storage chambers sometimes drop abruptly two or three feet below the regular working tunnels to the level of the living quarters. At intervals along the tunnels short side branches are used as sanitary conveniences, thus enabling the occupant to keep the main passageways in a habitable condition.

The courses of the underground workings are roughly indicated on the surface by series of piles of loose earth brought up through short side passages as the tunnels are extended. These little miners' dumps of earth vary with the size of the animal, sometimes containing more than two bushels. The outlets of the passages leading to the surface are kept plugged with loose earth. When these animals are numerous the ground is thickly dotted in all directions with earth piles, and the caving caused by the network of tunnels just below the surface renders walking difficult. The perpetual industry of these rodent miners outclasses that of the proverbial beaver.

Gophers are both diurnal and nocturnal, the gloom of their tunnels scarcely varying except when one of the outlets is temporarily opened. They are averse to light, and if the plug to a freshly made opening is removed the observer may soon catch a glimpse of the owner as he suddenly thrusts his head into view for a moment before again plugging the door with earth.

Gophers dig their tunnels by using their teeth and the strong claws on the front feet. The loose earth is pushed along the tunnel by the head, the palms of the front feet, and the breast in little jerky movements until it is ejected on the surface dump.

Owing to their poor sight, heavy bodies, and short legs, gophers are clumsy and deliberate in their movements and peculiarly helpless in the open. Apparently appreciating this, they rarely venture from their underground shelter by day except when in grain fields or similar sheltering vegetation. Here they sometimes run out two or three feet to cut down a succulent stalk and drag it hastily within the entrance of the tunnel, where it is cut into short sections and placed in the cheek pouches if to be used as food or left on the dump if the object of the cutting is finally to secure the seeds or head of ripening grain.

During the mating season in spring pocket gophers run about clumsily from one burrow to another and may often be seen on the surface by the light of the rising sun. Most of their short trips above ground are made at night, when they sometimes swarm out and wander over a limited territory. Their night wanderings are proved in California by the many bodies which the morning light often reveals in the sticky crude oil on newly oiled roads which the gophers have tried to cross.

From one to seven young are born in a litter, but whether there is more than one litter in a season or not is unknown. The young when about half grown migrate to unoccupied ground sometimes one or two hundred yards from the home location and make tunnels of their own.

The food of pocket gophers consists mainly of tubers, bulbs, and other roots, including many of a more woody fiber. Whole rows of potatoes or other root crops are cleaned up by the extension of tunnels along them. Sometimes the animals follow a row of fruit trees, cutting the roots and killing tree after tree. In grain and alfalfa fields they are great pests, and in irrigated country their burrows in ditch banks often cause disastrous breaks.

The big tropical species sometimes exist in such numbers as to render successful agriculture very difficult. Sugar-cane planters in many parts of Mexico and Central America are compelled to wage unremitting war on them to avoid ruin. I know of an instance on a plantation in Vera Cruz in which thousands were killed during a single season without stopping the damage from these pests, which swarmed in from the adjacent area.

The large external cheek pouches of pocket gophers are used solely for gathering such food supplies as seeds, small bulbs, and sections of edible roots or plant stems and transporting them to storage chambers located along the sides of the tunnels. Food is placed in the pouches by deft sidewise movements of the front feet used like hands, and so quick are they that the motions of the feet can scarcely be detected. The pockets are emptied by placing the front feet on the back ends of the pouches and pushing forward, thus forcing out the contents. In their tunnels gophers run backward and forward with almost equal facility, the sensitive naked tail serving to guide their backward movements.

Pocket gophers are stupid solitary little beasts, with surly dispositions, and fight viciously when captured or brought to bay. This attitude toward the world is justified by the host of enemies ever ready to destroy them. Among their more active foes are snakes and weasels, which pursue them into their tunnels; and badgers, which dig them out of their runways.

They are also persistently hunted day and night by foxes and coyotes. Moreover, by day various kinds of hawks watch for them to appear at the entrances of their dens, and by night the owls, ever alert, capture many.

When one gopher intrudes into the tunnel of another the owner at once fiercely attacks it. In some places I have seen Mexicans take advantage of this characteristic pugnacity by fastening the end of a long string about the body of a captured gopher and then turning it into an occupied tunnel, through a recently made opening. The owner, scenting the intruder, would immediately attack him, the combatants locking their great incisors in a bulldog grip.

The movements of the string would give notice of the encounter, and by pulling it out

XUM

steadily both animals could be drawn forth and the enraged owner of the burrow dispatched. In this manner I have known an Indian to catch more than a dozen gophers in a few hours.

Pocket gophers are active throughout the winter even in the coldest parts of their range, but in many places must rely largely on food accumulated in their storage chambers.

Melting snow in the mountains and in the North reveals the remains of many tunnels made through it along the surface of the ground. These snow tunnels are often filled for long distances with loose earth brought up from underground, and after the snow disappears in spring the curious branching earth forms left, winding snakelike through the meadows, are a great puzzle to those who do not know their origin.

In a state of nature pocket gophers are constantly bringing the subsoil to the surface and burying humus. Over an enormous area they exist in such countless thousands that their work, like that of angleworms, is often of the most beneficial character. On bare slopes, however, their work is highly injurious, as it greatly increases erosion of the fertile surface soil and thus has its direct influence in changing world contours.

When civilized man arrives in their haunts and upsets natural conditions with cultivated crops the new food supply stimulates an increase in the gopher population and their activities immediately become excessively destructive and necessitate unremitting warfare against them.

THE KANGAROO RATS (Dipodomys spectabilis and its relatives)

(*For illustration, see page 416*)

The desert regions of western North America have developed several peculiar types of mammals, and among them are none handsomer or more interesting than the kangaroo rats. These rodents, despite their name, are neither kangaroos nor rats, but are near relatives of the pocket mice, which share their desert haunts.

All are characterized by a kangaroo-like form, including small fore legs and feet, long hind legs and feet for jumping, and a tail longer than the body to serve as a balance. In addition, they have large, prominent eyes and are provided with skin pouches on each side of the mouth for use in holding food to be carried to their store chambers.

The color pattern, like the form, of the kangaroo rats is practically uniform throughout the group. Both are well shown in the accompanying plate of *Dipodomys spectabilis*, the largest and most strongly marked species. Its total length is from 12 to 14 inches; most of the other species are much smaller.

Kangaroo rats of many species are distributed over most of the arid and semiarid regions of the United States and Mexico, from Nebraska, Oklahoma, and the Gulf Coast of Texas west to the Pacific coast, and from Montana and Washington southward to the Valley of Mexico and throughout Lower California. They are especially numerous in the southwestern deserts, where they are the oddest and most picturesque of animals.

Although they have no near relatives in the Old World, some of the African and Asiatic jerboas are externally almost perfect replicas of the kangaroo rats in every detail of form, color, and color pattern, even to the tail markings. This extraordinary likeness in appearance of two widely separated and unrelated animals is made doubly significant by the fact that both live in deserts and have similar habits.

Peculiarly desert animals, kangaroo rats live like the pocket mice, without drinking, but obtain the necessary water through their digestive processes. They are most numerous in sandy areas, and there the earth is sometimes so riddled by their burrows as to render horseback riding difficult.

Kangaroo rats are nocturnal and always live in burrows dug by themselves. As a rule they prefer soft or sandy ground, but some species occupy areas where the earth is hard and rocky. The burrows of some species have only one or two entrances with a small amount of earth thrown out, but others make little mounds with several openings, entering usually nearly on a level or at a slight incline. These openings are nearly always conspicuous, and while frequently near bushes, no effort appears ever to be made to conceal them, and a little trail often leads away through the soft earth.

The large *Dipodomys spectabilis*, which lives mainly in New Mexico and Arizona, constructs the most notable of all the dwelling places of these animals. From its underground workings it throws up large mounds of earth, which gradually increase in size with the length of time they are occupied until they are sometimes more than 3 feet high and 15 feet or more in diameter. From three to a dozen burrows enter these mounds, usually at the surface level of the ground, but some are on the slopes of the mound. The mounds, usually located in open ground, with their round entrance holes from four to five inches in diameter, are extremely conspicuous.

Although generally scattered at varying distances from one another, the mounds are sometimes grouped in colonies. Well-worn trails three or four inches broad lead away from the entrances, some to other mounds showing neighborly intercourse and others far away to the feeding grounds, sometimes 200 or 300 yards distant. One of the openings at the side of the mound is usually the main entrance, and by day this is ordinarily kept stopped with fresh earth. Within the mound and farther under ground are dug a series of ramifying passages, among which are located roomy nest chambers and store-rooms for food.

Kangaroo rats are not known to hibernate in any part of their range. They lay up food for temporary purposes at least and do not go abroad in stormy or cold weather. The north-

XUM

ern species and those on the colder mountain slopes must make large store against the winter needs. Their food consists mainly of seeds, leaves of several plants, and of little plants just appearing above ground. Tiny cactus plants and the saline fleshy leaves of *Sarcobatus* are often among the kinds gathered for food.

The big *Dipodomys spectabilis* appears to be more social than most of its kind, as several may be caught in a single mound, and, as already said, well-worn trails lead from mound to mound. A little noise made just outside one of these mounds usually brings a reply or challenge in the form of a low drumming or thudding noise, no doubt made by the animal rapidly striking the ground with its hind feet like a rabbit or wood rat.

When caught they at first struggle to escape, but, like a rabbit, do not offer to bite, and soon become quiet. They have from two to six young, which may be born at any season. Nothing appears to be known concerning the number of litters in a year.

When in camp at San Ignacio, in the middle of the desert peninsula of Lower California, I had an unusual opportunity to learn something of the habits of one of the smaller species of kangaroo rat abundant there. The moon was at its full, and in the clear desert air its radiance rendered objects near at hand almost as distinct as by day. Scattered grains of rice and fragments of food on the ground about the cook tent attracted many kangaroo rats and pocket mice.

During several nights I passed hours watching at close range the habits of these curious animals. As I sat quietly on a mess box in their midst both the kangaroo rats and the mice would forage all about with swift gliding movements, repeatedly running across my bare feet. Any sudden movement startled them and all would dart away for a moment, but quickly return.

Although the kangaroo rats did not become so fearless and friendly as the pocket mice, they were so intent on the food that at times I had no difficulty in reaching slowly down and closing my hand over their backs. I did this dozens of times, and after a slight struggle they always became quiet until again placed on the ground, when they at once renewed their search for food as though no interruption had occurred.

One night, to observe them better, I spilled a small heap of rice on the sand between my eet. Within two or three minutes half a dozen kangaroo rats had discovered it and were busily at work filling their cheek pouches with the grains and carrying them away to their store chambers.

While occupied in this rivalry for food they became surprisingly pugnacious. If one was working at the rice pile and another rat or a pocket mouse approached, it immediately darted at the intruder and drove it away. The mode of attack was to rush at an intruder and, leaping upon its back, give a vigorous downward kick with its strong hind feet. Once I saw a pocket mouse kicked in this way. It was knocked over and for a minute or more afterwards ran about in an erratic course, squeaking loudly as though in much pain.

Sometimes the pursuit of one kangaroo rat by another continued for twenty yards or more. By the time the pursuer returned another would be at the rice pile and it would immediately dash at the victor of the former fray and drive him away. In this way there was a constant succession of amusing skirmishes.

Sometimes an intruder, bolder than the others, would run only two or three yards and then suddenly turn and face the pursuer, sitting up on its hind feet like a little kangaroo. The pursuer at once assumed the same nearly upright position, with its fore feet close to its breast. Both would then begin to hop about watching for an opening. Suddenly one would leap at the other, striking with its hind feet exactly like a game cock. When the kick landed fairly on the opponent there was a distinct little thump and the victim rolled over on the ground. After receiving two or three kicks the weaker of the combatants would run away.

The thump made by the kick when they were fighting solved the mystery which had covered this sound heard repeatedly during my nights at this camp. The morning light revealed a multitude of little paired tracks made by the combatants in these battles. Such tracks in the sand have been referred to as the "fairy dances" of these beautiful little animals, but the truth revealed proves them to be really "war dances."

THE BANDED LEMMING (Dicrostonyx nelsoni and its relatives)

(*For illustration, see page 417*)

Banded lemmings are unique among the mouse tribe in their change from the rufous brown, or gray summer coat to pure white in winter. With the assumption of the white winter fur a thick, horny, padlike growth develops on the underside of the two middle claws of the front feet, which is molted in spring when the winter coat is lost. For an animal living in the far North the usefulness of a white coat in winter is evident, but no good reason is apparent for these curious claw-pads.

The summer coat varies remarkably in color and color pattern, and many of the lemmings in their beautiful shades of chestnut, browns, or grays are very handsome. They are more heavily proportioned than field mice and the very long fluffy fur, which completely conceals the rudimentary ears and tail, tends to exaggerate their size.

The banded lemmings form a strongly marked group, containing a number of species inhabiting circumpolar regions. In North America they occur nearly everywhere in the arctic and subarctic parts, including Greenland, most of northern Canada, including the Arctic islands, and a large part of Alaska, including some of the Aleutian Islands.

They range as far northward as vegetation affords them a proper food supply and have been well known to many of the explorers of

XUM

those stern northern wilds. To the southward they extend into the subarctic northern forests, where they usually keep to the open barren areas.

Not much is known of their life histories on this continent. They are mainly nocturnal and live in burrows from two to three feet long, ending with a nest chamber four or five inches in diameter, warmly lined with grass and moss. Near the nest there is usually a branch burrow a foot or more long which is used for sanitary purposes and as a place of refuge when the main burrow is invaded.

In the nests during early summer litters generally containing about three young are brought forth. Ordinarily the burrows open in unsheltered places, but in wooded regions may be under a log or beneath a bush or the roots of a tree. No runways lead out from the burrows as is customary with many of their relatives. They are active throughout the winter, making many tunnels along the surface of the ground under the snow, which are revealed when it melts in spring.

These surface tunnels are their foraging roads, safe from most of the fierce storms which rage overhead. At times, however, the snowy shelter is blown away or some other cause brings the lemmings to the surface, where they blunder aimlessly about, soon to be captured by some enemy or to perish from the cold. As their infrequent appearance on top of the snow is usually during storms, the Alaskan Eskimos have a legend that these white lemmings live in the land above the stars and descend in a spiral course to the earth during snowstorms.

Although banded lemmings never become so extraordinarily numerous over great areas as the brown species, they become very abundant at times in the barren grounds of Canada and the Arctic islands and migrate from one part of their range to another. The best observation in regard to this was made by Rae in June at the mouth of the Coppermine River. On the west bank of the river north of the Arctic Circle he encountered thousands of them speeding northward.

The ice on some of the smaller streams had broken up and he was amused to see the little animals running back and forth along the banks looking for a smooth place in the stream, indicating a slow current, where they could swim across. Having found such a place, they at once jumped in and swam quickly to the opposite side, where they climbed out and, after shaking themselves like dogs, continued their journey as though nothing had happened.

During the years I lived in northern Alaska the advent of winter was marked by invasion of the storehouses by many brown lemmings and other mice, but banded lemmings rarely appeared. When occasionally captured alive, the old ones fought viciously, but the young were gentle and quickly became tame and interesting pets. Their skins were highly prized by the little Eskimo girls to make garments and robes for their walrus ivory dolls.

THE BROWN LEMMING (Lemmus alascensis and its relatives)

(*For illustration, see page 417*)

Few small mammals are so well known in far northern lands as the brown lemmings. They form a small group of species having a close general resemblance to some of the field mice, from which, however, they may at once be distinguished by their much heavier proportions, extremely short tails, and the remarkable length of the hair on their backs and rumps.

They inhabit most of the arctic and subarctic lands of both Old and New Worlds. In North America they are known from the northernmost lands, beyond 83° north latitude, to the southern end of Hudson Bay, and throughout most of northern Canada and all of Alaska, including the islands of Bering Sea.

The extraordinary migrations of these lemmings have attracted attention far back in the early history of northern Europe. At intervals, through favorable conditions, they become superabundant over a large area, and then a sudden resistless desire to migrate in a certain direction appears to seize the entire lemming population. The little beasts start in a swarming horde, sometimes containing millions, and traverse the country.

In their travels they appear indifferent to all obstacles and with dogged and unwavering persistence swim the streams and lakes encountered on their way. Similar migrations have been observed at various points in Arctic America, several of them in Alaska, where the lemmings abound on the open tundras.

These migrations sometimes continue for more than one season, the animals meanwhile being killed in countless numbers by disease, by accident in field and flood, and, in addition, through the heavy toll taken from their numbers by their winged and four-footed foes, which always gather in numbers to accompany them.

The migrations sometimes wear out through the diminution in numbers, and sometimes when they reach the sea, as in Norway, they are said to enter the water and swim offshore until they perish. When one of these swarms of rodents passes through a farming district it cleans up the crops and other surface vegetation like a visitation of locusts.

These lemmings do not hibernate, but, active throughout the severest winters, are abroad almost equally by day and by night. Their burrows consist of winding tunnels, often many-branched and with more than one opening. A dry bed of peat or a dense growth of moss is often pierced by a network of them. Well-defined runways often lead away from the burrows or from the entrance of one burrow to that of another.

Their tunnels run everywhere under the snow, with occasional passages leading to the surface. When fierce gales blow away the snow or a winter rain melts it, many lemmings lose touch with their burrows and wander about until they perish from cold or are caught

by some enemy. They are sometimes found several miles from shore, where they have strayed out on the sea ice.

In winter in the fur countries, in company with field mice, they invade storehouses and habitations in search of food. Among their enemies are ravens and all northern hawks and owls, as well as foxes, weasels, lynxes, bears, and other beasts of prey of all degree.

Within their underground tunnels and often in dense vegetation on the surface lemmings make warmly lined nests of grass and moss in which their young, from two to eight in number, are born. The young appear at varying times, thus indicating several litters each year.

When taken alive, the old ones are fierce and courageous, growling and fighting savagely; but several half-grown young brought me during my residence in Alaska proved to be most amusing and inoffensive little creatures. From the first they permitted me to handle them without offering to bite and showed no signs of fear.

They were kept in a deep tin box, from which they made continual efforts to escape. When I extended one finger near the bottom of the box they would stand erect on their hind feet and reach up toward it, using their forepaws like little hands. If my finger was lowered sufficiently they would climb up into my hand and thence to my shoulder, showing no sign of haste, but much curiosity, continually sniffing with their noses and peering at everything with their bright beadlike eyes.

They were curiously expert in walking on their hind feet, holding the body in an upright position and taking short steps. If anything was held just out of reach above their heads, as the point of my finger, they would continue in an erect position for a considerable time. At such times they would reach up with their front paws and often spring up on their hind feet for half an inch above the floor trying to touch it. When eating they sat upright on their haunches, like little marmots, and held the food in their front paws.

THE COMMON FIELD MOUSE, OR MEADOW MOUSE (Microtus pennsylvanicus and its relatives)

(*For illustration, see page 420*)

The Pennsylvania meadow mouse is a small species about as long in body as the house mouse, but much more heavily proportioned. Its head is rounded, the eyes small and beadlike, the legs and tail are short, and the comparatively coarse fur is so long that it almost conceals the short, rounded ears.

It is a typical representative of a group of small mammals commonly known as field mice, or "bear mice," which includes a great number of species closely similar in general appearance, but varying much in size. In England they are termed voles, and large species living about the water in England and northern Europe are known as "water rats."

Field mice are circumpolar in distribution and abound from the Arctic barrens, beyond the limit of trees, to southern Europe and the Himalayas, in the Old World, and to the southern United States and along high mountains through Mexico and Guatemala, in Central America. They occur in most parts of the United States except in some of the hotter and more arid sections.

As a rule field mice prefer low-lying fertile land, as grassy meadows, but the banks of streams, the rank growths of swamps and marshes, the borders of damp woodlands, the grassy places on Arctic tundras, or the dwarfed vegetation of glacial slopes and valleys above timber-line on high mountains furnish homes for one species or another.

Two, and even three, species of field mice are sometimes found in the same locality, but each kind usually occupies a situation differing in some way from that chosen by the others. Some occupy comparatively dry ground and others, like the European water rat, live in marshes and are almost as aquatic as the muskrat. Most species living about the water are expert in diving and in swimming, even under water. In streams inhabited by large trout they are often caught and eaten by the fish.

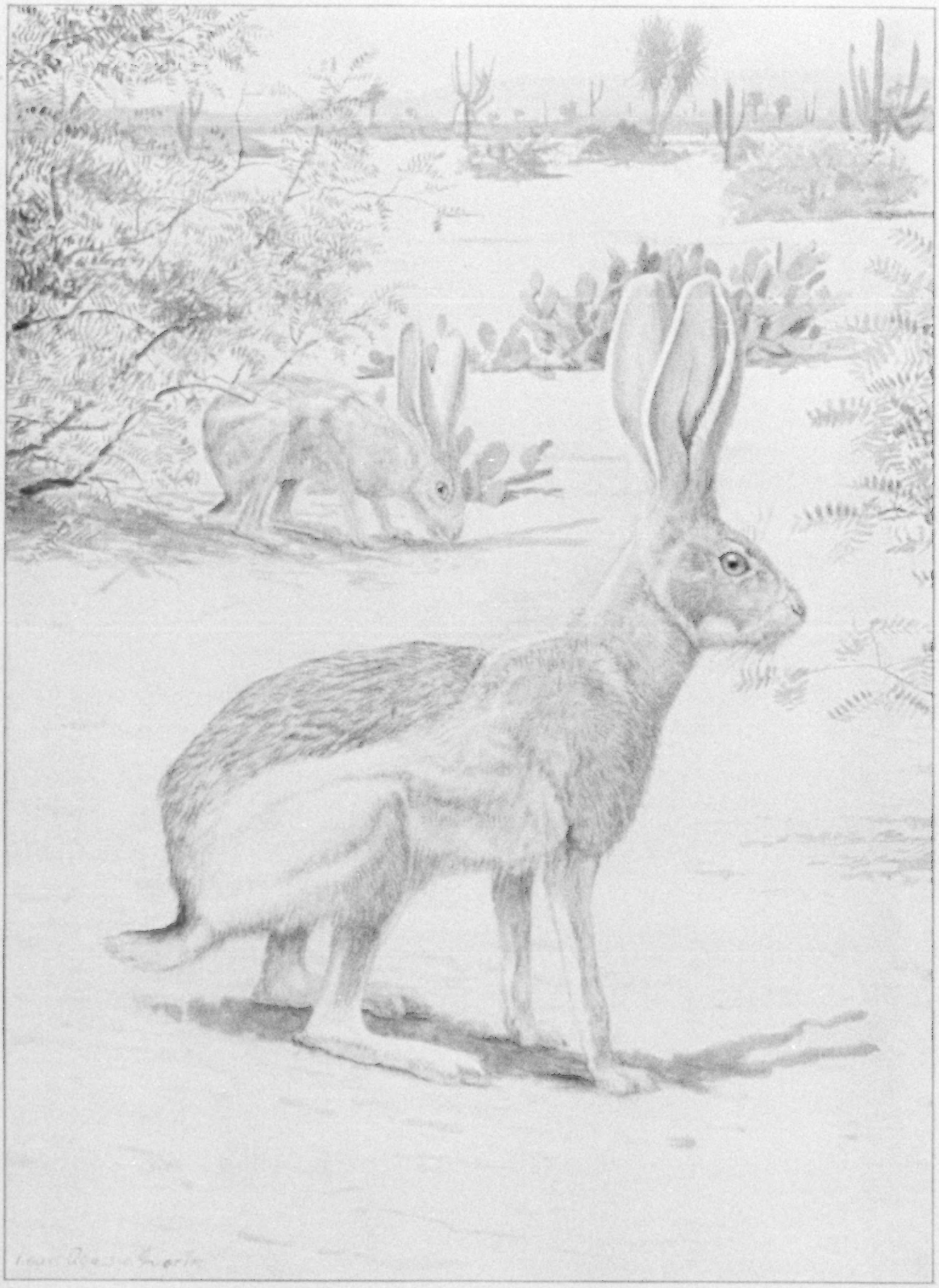
The presence of field mice is nearly always indicated by smoothly worn little roads or runways about an inch in width, which form a network among the vegetation in their haunts. These runways lead away from the entrances of their burrows and wind through the vegetation to their feeding grounds. They are kept clean and free from straws and other small obstructions, so that the owners when alarmed may run swiftly to the shelter of their burrows. Fully conscious of their helplessness, meadow mice are as cautious as the necessities of existence will permit.

Their burrows are often in the midst of grassy meadows, as well as under the shelter of logs, rocks, tussocks of grass, or roots of trees, and lead to underground chambers filled with large nests of dry grass, which shelter the owner in winter and often in summer. The summer nests in many places, especially in damp meadows or marshes, are made in little hollows in the surface or in tussocks of grass. In these nests several litters containing from four to eleven young are born each year.

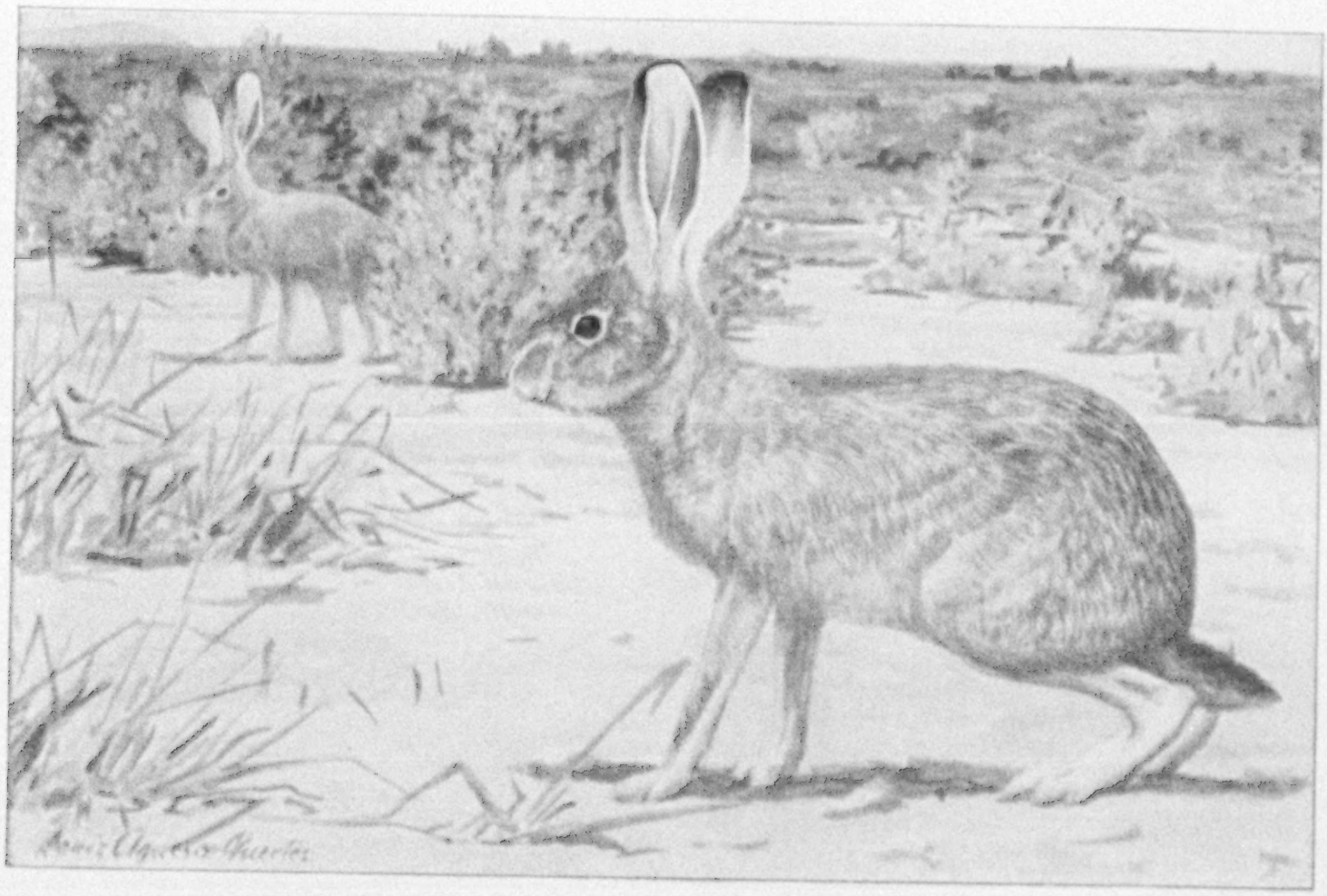
It is rarely that an observer is located where he can study the every-day lives of little animals like the meadow mice and at the same time go on with his regular occupation. At one of my mountain camps in Mexico I fortunately pitched my tent on a patch of lawn-like grass in front of the ruins of an abandoned hut. Runways of field mice formed a network everywhere in the surrounding growth of grass and weeds.

For hours at a time as I worked quietly in the tent the many mice, unconscious of my presence, came silently along their little roads through the tall vegetation to the border of the short grass. Just within the shelter of the tall growth they would each time stop and remain watchfully immovable for a half minute, and then, if everything was quiet, make a swift run

XUM



ANTELOPE JACK RABBIT
Lepus alleni



CALIFORNIA JACK RABBIT
Lepus californicus

VARYING HARE, or SNOWSHOE RABBIT
Lepus americanus

two or three feet into the open, bite off a tender little grass blade and dash back to the sheltered road. There they would sit up squirrel-like, holding the grass blades in their forepaws and eating them rapidly, or would sometimes carry the food back to the burrows.

Occasionally as the mice darted into the open I made a slight squeaking noise and perhaps two or three in sight at the time would instantly turn and dash back into the sheltered road, sometimes not reappearing for a long time. Again and again I saw them come into the open for food, and before securing it suddenly scamper back in a panic without apparent cause for alarm.

Eternal vigilance is the only defense such animals have, and despite their watchfulness myriads of them are devoured daily by a large number of rapacious birds and mammals, including even such huge beasts as the great Alaskan brown and grizzly bears, which dig them from their burrows on grassy northern mountain sides.

Despite their numerous natural enemies field mice are so prolific they continue among the most destructive of agricultural pests. They are so obscure and the damage by a single mouse appears so insignificant, that it requires a knowledge of their habits, their wide distribution, and their enormous numbers to appreciate what a serious drain they are on the farmer's income, even when in their normal numbers.

In summer they feed on growing grass, clover, alfalfa, and grain, seeds, bulbs, root crops, and garden vegetables. In fall they congregate under shocks to feed on the grain, and in winter often do enormous injury to young or even well-grown fruit and other trees by gnawing off the bark on the base of the trunk and roots, sometimes in this way destroying entire orchards and nurseries.

One species in California destroys large quantities of raisins drying in the field by carrying them off to some shelter, where they cut out the seeds and leave the rest of the fruit. I have seen half a pound of raisins under a piece of board, the result of the night's work of a single mouse.

While field mice are always destructive, at intervals they have sudden and mysterious accelerations of increase and become so excessively abundant that they are a veritable plague. Many instances of this are on record in the Old World, where they have become so numerous as to call forth governmental intervention.

The most notable recent outbreak of this kind in the United States took place in the Humboldt Valley, Nevada, where, during the winters from 1906 to 1908, they swarmed over the cultivated parts of the valley and completely destroyed 18,000 acres of alfalfa, even devouring the roots of the plants. During this outbreak the mice in the alfalfa fields were estimated to number as high as 12,000 to the acre.

Whenever field mice become over-abundant notice appears to go out among their natural enemies, and in extraordinary numbers hawks, owls, crows, ravens, sea gulls, coyotes, foxes, bobcats, weasels, and other animals appear to prey upon them.

At no season of the year are they free from their foes, for they remain active throughout the winter, and most species apparently lay up no winter store of food. They travel to winter feeding places through series of tunnels under the snow, and it is mainly at this season that they do the most serious damage to orchards and shrubbery.

In the far North at the beginning of winter they gather in large numbers about the fur-trading stations and other habitations, where they persistently invade the food supplies.

Some of the northern mice, however, gather stores of food for winter. A species living along the coast of the Bering Sea and elsewhere on the Arctic tundra of Alaska accumulates a quart or more of little bulbous grass roots, which are delicious when boiled. They are hidden in nests of grass and moss among the surface vegetation, and before the first snowfall I have seen the Eskimo women searching for them by prodding likely places with a long stick. The roots thus taken from the mice are kept to be served as a delicacy to guests during winter festivals.

THE PINE MOUSE (Pitymys pinetorum and its relatives)

(*For illustration, see page 420*)

The pine mice form a small group of species peculiar to North America and closely related to the field mice. They are similar in form to the common field mice of the Eastern States, but are usually smaller, with much shorter tails and shorter, finer, and more glossy fur.

Most of the pine mice are limited to the wooded region of the States between the Atlantic coast and the eastern border of the Great Plains, and from the Hudson River valley and the border of the Great Lakes south to the Gulf coast. Strangely enough, one species lives in a restricted belt covered with tropical forest along the middle eastern slope of the Cordillera, which forms the eastern wall of the Mexican tableland, on the border between the States of Vera Cruz and Puebla.

Pine mice occupy the borders of thin forests and brushy areas, from which they work out into the open borderlands, especially in orchards or other places where there are scattered trees amid a rank growth of weeds. Instead of making their runways among growing vegetation on the surface of the ground like field mice, they live in little underground tunnels or burrows which extend in all directions through their haunts. These tunnels are closely like those of the common mole except that they are smaller and have frequent openings to the surface, through which the owners make short excursions for food. They often utilize the tunnels of moles when conveniently located for their purposes.

The tunnels are often so near the surface that the ground is slightly uplifted or broken as by a mole, or they are made under the fallen

XUM

leaves and other small decaying vegetable matter covering the ground under the trees. Occasionally, when the surface soil becomes dry and hard, the burrows are deeper, so that no surface indications can be discovered. On account of the similarity of their burrows the depredations of pine mice are commonly attributed to moles.

Several inches below the surface pine mice excavate oval chambers to be used for nests or for storage purposes. The nest chambers have several entrances from ramifying tunnels and are filled with short fine pieces of grass, making a warm nest-ball. Here the several litters of young are born each year. Pine mice are less prolific than field mice, however, and the litters contain only from one to four young.

The food chambers are larger than the nest chambers, and when full of stores are kept closed with earth. In these are stored short sections of green or dry grasses, bulbous grass roots, and short sections of other edible roots. One such store contained about three quarts of the fleshy roots of a morning glory cut into short sections.

Pine mice obtain much of their food from the bark about the bases and roots of trees, including both coniferous and deciduous species. They kill many small trees and shrubs by girdling, or by cutting the roots below the surface, and in this way frequently inflict severe damage in orchards and nurseries. Owing to their underground habits they are much more dangerous to orchards than field mice. They also do much damage by burrowing along rows of potatoes and other root crops, upon which they feed.

Both pine mice and field mice are serious pests to agriculture and only by vigilant care can they be prevented from steadily reducing the returns from farm and orchard. A mouse appears so insignificant an enemy that the general inclination among farmers is to ignore it, but both field and pine mice exist in such enormous numbers and are so generally distributed that the aggregate annual losses from them are great.

Clean cultivation in orchards, especially for some distance immediately about the trees, is an excellent protective measure against both of these mice. The shrubbery and fruit trees of orchards, lawns, and gardens may be protected by the use of poisoned baits and traps as soon as signs of pine mice or field mice are observed.

THE RED-BACKED MOUSE (Evotomys gapperi and its relatives)

(*For illustration, see page 421*)

With the exception of the banded lemmings the red-backed mice are the most brightly colored of the smaller northern rodents. They are close relatives of the common field mice, which they about equal in size, but from which they are distinguished externally by rufous coloration, finer and more glossy pelage, larger ears, and proportionately longer tails.

The red-backed mice form a group containing a considerable number of species distributed throughout the northern circumpolar lands, except on the barren islands of the Arctic Sea. In North America they occur from the Arctic tundras north of the limit of trees southward throughout Alaska and Canada to the northern United States. With other northern species of mammals, birds, and plants they follow the high mountain ranges still farther southward to North Carolina, New Mexico, and middle California.

It is true that in the far North they are numerous on the moss-grown tundras, and in the South range above timber-line on high mountains. As a general rule, however, they are woodland animals, whether among the spruces, birches, and aspens of the North or farther south in the United States in the cool fir and aspen-clad slopes of mountains. They also frequent old, half-cleared fields, brush-grown or rocky areas, and similar places where cover is abundant.

Although so closely related to the field mice, the red-backed species are not known to become excessively abundant nor seriously to injure crops. One reason for their harmlessness in this respect may be their strong preference for forest haunts.

I once found them numerous in the grass-grown streets and yards of an abandoned mining camp in the forest at the head of Owens River, in the Sierra Nevada, of California. The mice were making free use of the congenial shelter afforded by the old log cabins, and their runways and entrances to burrows were all about under scattered boards and similar cover.

They are abroad equally by day and by night, and for this reason are better known to woodsmen than most of the small woodland animals. When foraging by day among the fallen leaves and deep green vegetation they present a most graceful and attractive sight, now moving about with quick and pretty ways, now pausing to sit up squirrel-like to eat some tid-bit held in the front paws and then on the alert to detect a suspected danger and poised in quivering readiness for instant flight.

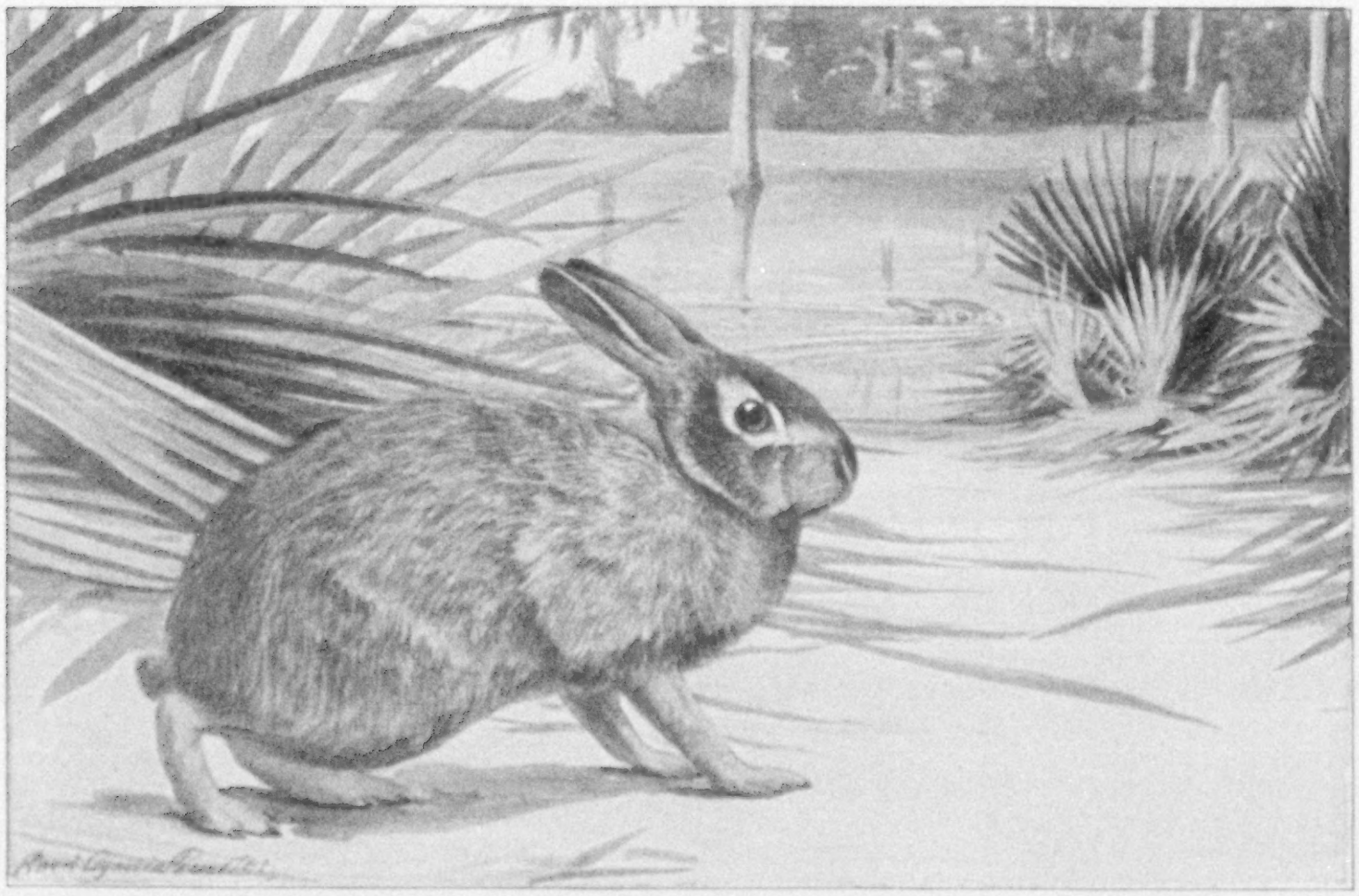
Red-backed mice usually live in underground burrows similar to those of field mice, but generally located with more care in dry situations, the entrances sheltered by a stump, old log, root of a tree, rock, or other object. Ordinarily they do not make such well-defined runways as do many field mice, and sometimes no trace of a trail can be found leading away from their burrows. But where they travel about through small dense vegetation, under logs and about stumps and rocks they often make well-marked trails.

Their nests are bulky and formed of a mass of fine dry grass, moss, and other soft material, which is sometimes located in an underground chamber opening off the burrow and sometimes in hollow stumps and logs or under other surface shelters. But little is known about the home life of these mice except that they are prolific, and between April and October have several litters containing from three to eight young in each.

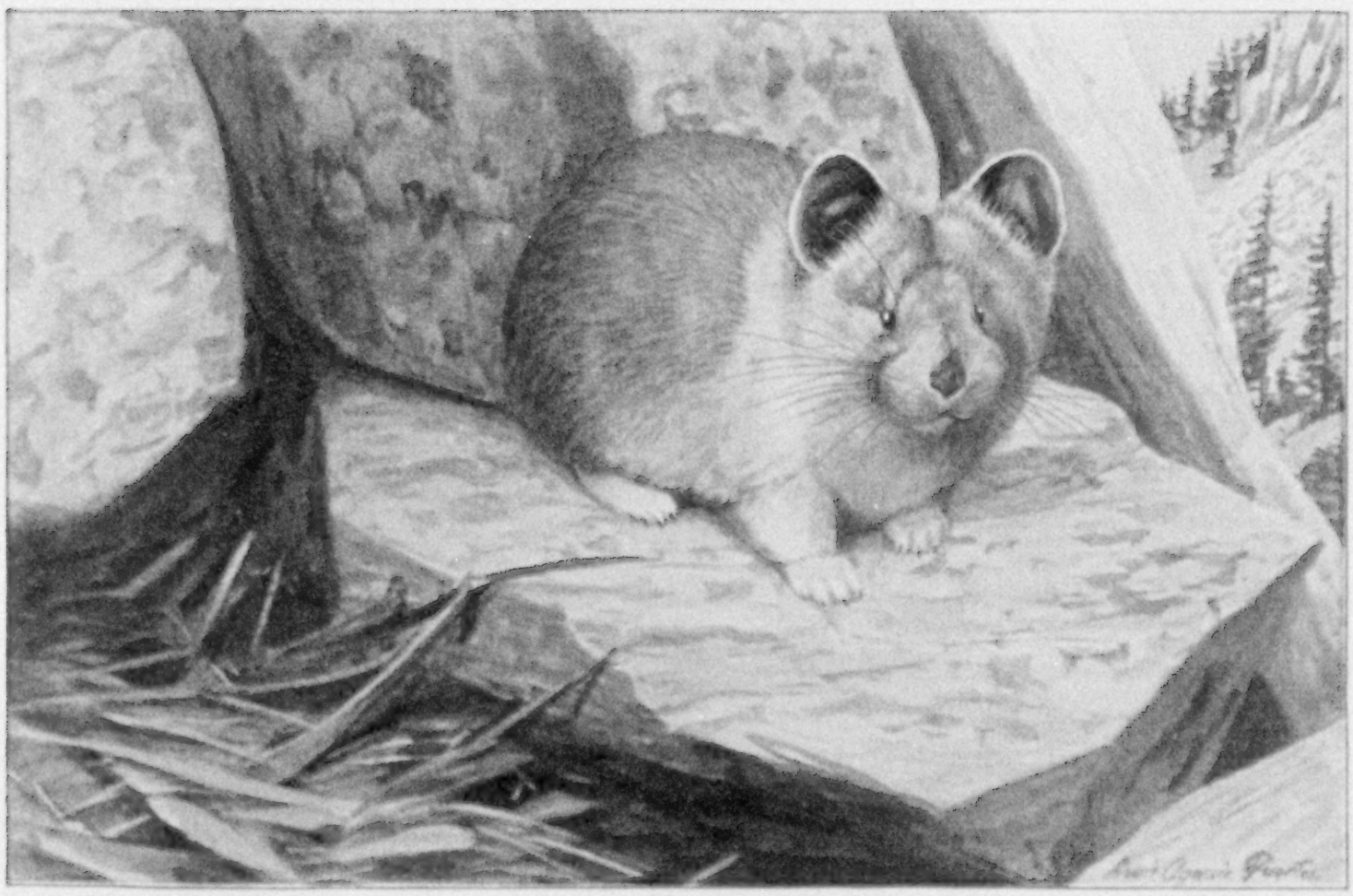
XUM

ARCTIC HARE
Lepus arcticus

COTTONTAIL RABBIT
Sylvilagus floridanus



MARSH RABBIT
Sylvilagus palustris



PIKA, LITTLE CHIEF HARE, or CONY
Ochotona princeps

They feed upon a great variety of seeds, fruits, roots, and succulent vegetable matter and lay up stores for winter in underground chambers or in hollow logs and similar places above ground.

With the coming of winter they gather about cabins and other habitations in their territory and become as persistent as house mice in searching out and raiding food supplies of all kinds. When the more appreciated kinds of food fail they resort to gnawing the bark from roots and bases of trunks of small deciduous trees of various kinds.

During my sledge journeys in the region about Bering Strait I found the skins of many red-backed mice among the Eskimo children. The small boys kept them with lemming skins as evidences of their prowess with miniature dead-fall traps and blunt-pointed arrows, and the little girls kept them as prized robes for the dolls carved by their fathers from wood or walrus ivory.

THE RUFOUS TREE MOUSE (Phenacomys longicaudus and its relatives)

(*For illustration, see page 421*)

The genus Phenacomys, to which the rufous tree mouse belongs, includes a number of species closely similar in size and external appearance to some of the well-known field mice. The structure of their teeth, however, shows that they form a distinct group of animals.

So far as known, the living members of the genus are confined to the Boreal parts of North America, where they range from the Atlantic to the Pacific in Canada, and southward along the mountains to New Hampshire, New Mexico, and northern California. The discovery of fossil representatives of the genus in Hungary and England indicates that it was formerly circumpolar in distribution.

All but one species of the genus live on the ground, inhabit burrows, make runways through the small vegetation, and feed on grasses and other herbage—all in close conformity with the habits of the meadow mice.

The tree mouse, however, is a strongly aberrant member of the group. It differs from all the others, and from all field mice, not only in its rufous color and longer tail, but in its remarkable mode of life. It is restricted to the humid region of magnificent forests in western Oregon and northwestern California, where it often spends its life in the tops of such noble trees as the Sitka spruce, the Douglas fir, and the coast redwood. Such an amazing departure from the habits of its kind lends unusual interest to this little animal.

Its nests are generally located high up in the trees, sometimes 100 feet from the ground, in forests where the branches of neighboring trees interlace so that it can pass from one to another and inhabit a world of its own, free from the ordinary four-footed enemies which prowl below.

The nests vary in size, structure, and location. In Oregon they have been found only in large trees at elevations varying from 30 to 100 feet. On the seashore near Eureka, California, they are placed on the branches of small second-growth myrtle and redwood trees. Farther inland in the same region many are in small trees, within a few yards of the ground, on the border of heavy redwood forests.

The higher nests of the tree mice are often the deserted and remodeled homes of the big gray tree squirrel of that region (*Sciurus griseus*) and contain a foundation of coarser sticks than in the nests wholly built by the mice. The larger proportion of the nests are built by the mice and are usually composed of small twigs, fragments of a netlike lichen, skeletons of fir, spruce, or other coniferous leaves, and the droppings of the mice themselves. They vary from small oval structures a few inches in diameter, located well out on the branches, to great masses close against and sometimes entirely surrounding the tree trunks, supported on several branches, and measuring three feet long and two or three feet high.

The interior of these large structures is pierced with numerous passageways and sometimes as many as five separate nest chambers are scattered through one. Tunnels run out along each of the limbs on which the mass rests, and if it extends all the way round one main tunnel encircles the trunk from which these hallways branch.

Such great nests have evidently been used for a long period and have grown with the steady accumulation of material. This has gradually decayed and become a solid mass of earthy humus. The large nests are usually the abodes of a single female, the homes of the males having been found to be small and more often located away from the trunk of the tree. The food of the red tree mouse, so far as known, consists entirely of the fleshy parts of fir and spruce needles and the bark from coniferous twigs.

Tree mice appear to breed throughout most of the year and have from one to four young in a litter. They are mainly nocturnal, and when driven from their nests by day appear rather slow and uncertain in their movements. Those living in highly placed nests usually escape by running out on the limbs, and pass from one tree to another if necessary. Those in small trees usually drop quickly from limb to limb until they reach the ground, when they run to the nearest shelter.

That these mice sometimes descend to the ground of their own volition is probable, but the fact that the stomach of every individual so far examined has contained only the fleshy parts of coniferous leaves indicate that their food habits have become so fixed as to make arboreal life a necessity.

The modification of the habits of a member of a group of ground-frequenting animals, with a structure adapted to such an existence, to those of a strictly arboreal animal is so strange as to make the question of cause a puzzling one.

In the Hawaiian Islands the introduction of the mongoose has made the common house rat

XUM

arboreal in habits, and possibly in the remote past the pressure of some ground-frequenting enemy thus affected the lives of the red tree mouse. An animal rarely makes an abrupt change in its habits without direct pressure from some source, and then only as a matter of self-preservation.

THE MUSKRAT (Fiber zibethicus and its relatives)

(*For illustration, see page 424*)

The muskrat, or "musquash," as it is widely known in the northern fur country, is three or four times the size of the common house rat, to which it bears a superficial resemblance. It has a compactly formed body, short legs, and strong hind feet partly webbed and otherwise modified for swimming. The long, nearly naked, and scaly tail is strongly flattened vertically and in the water serves well as a rudder. The fur is nearly as fine and dense as that of the beaver and, as in that animal, protects its owner from the cold water in which so much of its life is spent.

Muskrats are peculiar to North America, where they exist in great numbers. Aquatic in habits, they have a wide distribution along streams of all sizes and among marshes, ponds, and lakes from the Atlantic to the Pacific, and from a little beyond the limit of trees on the Arctic barrens south throughout most of the United States. They reach our southern border at the delta of the Mississippi and the delta of the Colorado, at the head of the Gulf of California.

Within this vast area they have been modified by their environment into several species and geographic races, none of which differ much in appearance from the well-known animal of the Eastern States.

The nearest kin of the muskrats are the short-tailed field mice, so numerous in our damp meadows. Like the latter, the muskrat has several litters of young each season. The young are born blind, naked, and helpless, and number from three to thirteen to a litter. This great fecundity has enabled the muskrats to hold their own through years of persistent trapping.

They still occupy practically all their original range and yield a steady toll of valuable fur each season. In 1914 more than 10,000,000 of their skins were sold in London, and other millions were handled in America. The aggregate returns on muskrat skins are so great as to constitute it our most valuable fur-bearer. The furriers make its skins up in its natural color or dress and dye it and give it the trade names of "Hudson seal," "river mink," or "ondatra mink."

In suitable marshes, as on the eastern shore of Maryland, muskrats become extremely abundant and render such areas valuable as natural "fur farms." One Maryland marsh containing 1,300 acres has yielded from $2,000 to $7,000 worth of skins a year. Not only are the skins of value, but the flesh is palatable, and is sold readily under the trade name of "marsh rabbit" in the markets of Baltimore, Philadelphia, and elsewhere.

There is little doubt that owners of favorably situated marshes could derive from them a steady revenue by keeping them stocked with proper food plants and protecting the muskrats from their enemies. The value of these fur-bearers is becoming more and more appreciated and many States have laws restricting the trapping season to a period in fall and winter when the fur is prime.

In marshes about shallow lakes or bordering sluggish rivers muskrats build roughly conical lodges or "houses," three to four feet high, with bases, usually in shallow water, several feet broader. These houses are made of roots and stems of plants with a mixture of mud. An oval chamber is left in the interior, well above the water level, to which entrance is gained by one or more passageways opening under water. These shelters are mainly for winter use, but the young are sometimes born in them as well as in large grass nests among dense marsh vegetation.

The curious conical lodges are familiar objects about marshes in the Eastern and Northern States, and I remember seeing, a few years ago, a specially well-formed muskrat house close to the historic bridge at Concord, and others along the Concord River. Within ten years muskrat houses were common in marshy ponds in Potomac Park, Washington, where the Lincoln Memorial Building now stands.

Where the banks of streams or lakes rise abruptly, the muskrats make their home in dry chambers in the banks above water level at the end of a tunnel opening either under water or close to the water level. Worn trails lead up the banks about such places and well-marked runways are made through the heavy reeds and marsh grasses in their haunts.

Muskrats are mainly nocturnal animals, but often move about during the day. I have seen them repeatedly swimming close to the bank of the Potomac a short distance above Washington. They like to carry their food to slightly elevated points where they can overlook the water along shore, such as the top of a projecting log, large stone, or earthen bank, from which they plunge headlong at the first alarm. Many a solitary canoeman gliding silently along the shore of stream or pond at night has been startled by the disproportionately loud splash made by a muskrat diving from its resting place.

Their food consists mainly of the roots and stems of succulent plants varied with fresh-water clams, an occasional fish, and even by cultivated vegetables grown in places readily accessible from their haunts. They store up roots and other vegetable matter for winter use and remain active throughout that season. The roots of which their "houses" are built are frequently those used for food and sometimes serve as winter supplies.

As a rule, muskrats keep near their homes in winter, making excursions here and there beneath the ice. Sometimes the water rises and

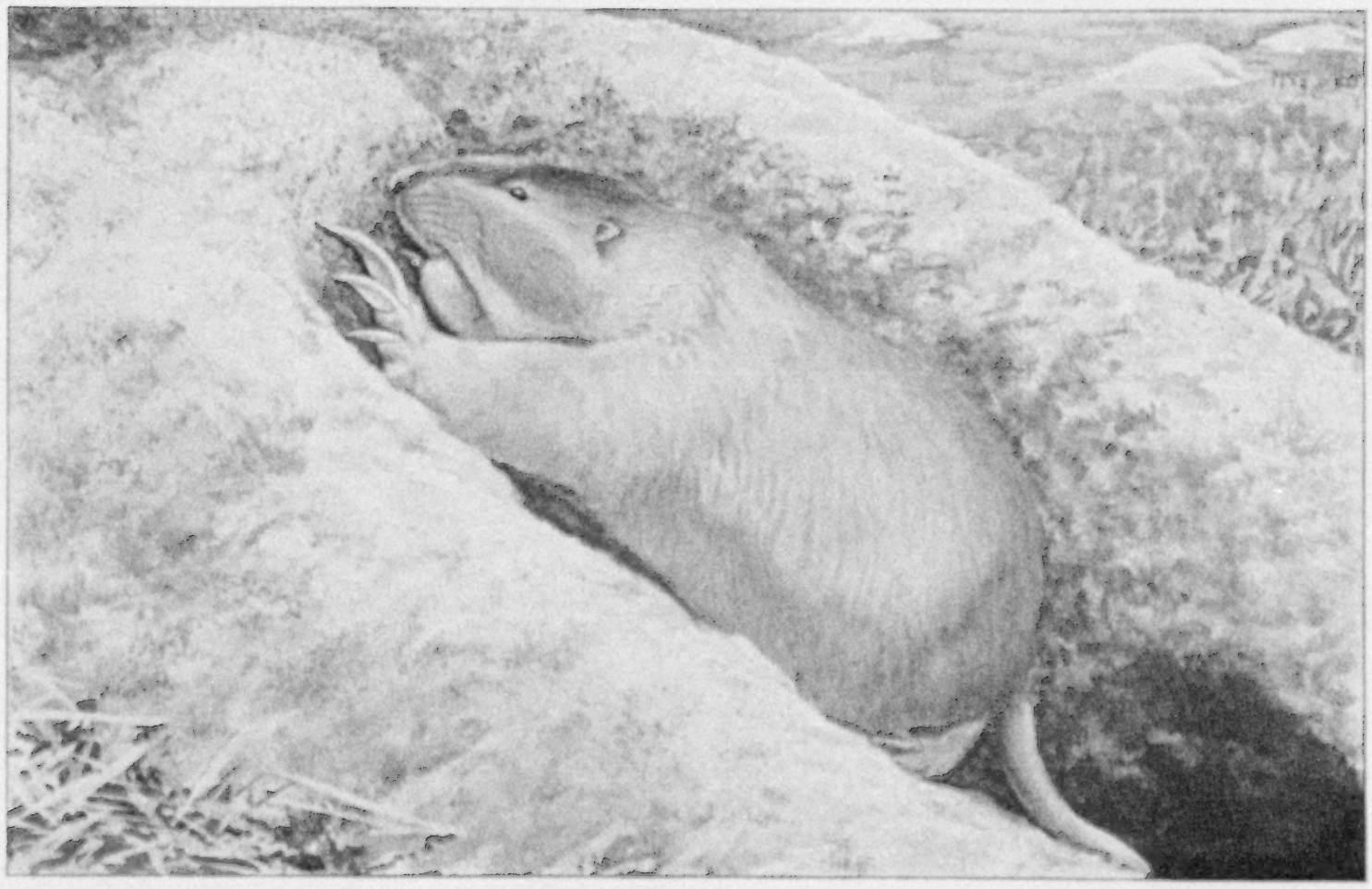
XUM

PORCUPINE
Erethizon dorsatum

JUMPING MOUSE
Zapus hudsonius

SILKY POCKET MOUSE
Perognathus flavus

SPINY POCKET MOUSE
Perognathus hispidus



POCKET GOPHER
Geomys bursarius

XUM

forces them out and they wander widely in search of new locations. When encountered at such times they show extraordinary courage and fiercely attack man or beast. The first muskrat I ever saw was one which a farmer met in midwinter in a snowy road in northern New York. As soon as the man drew near, the animal rushed at him with bared teeth and fought savagely until killed.

Muskrats are usually harmless animals and their presence in marshes and along watercourses lends a pleasant touch of primitive wildness to the most commonplace situations. They appear to have so adapted their habits to the presence of men that they go on with their affairs with curious indifference to their human neighbors. In irrigated country or elsewhere where banked ditches are built their habits render them serious pests, as their burrows and tunnels drain ponds or cause destructive washouts.

An interesting chapter in the history of these animals began in 1905, when four Canadian muskrats were introduced on a nobleman's estate in Bohemia. Since then they have increased rapidly and spread over a large area in Bohemia and beyond its borders. The streams in the region they occupy are controlled by grassy banks, and dams are built to form ponds for fish culture, which is a large industry there. The muskrats persistently tunnel into the banks and dams, causing them to give way, thus causing heavy losses to the owners.

They also work havoc among river crabs and mussels, which have great economic value, and interfere with the fish and their spawning beds. To cap the climax of their misdeeds, they are reported to feed on grain and vegetables and to destroy the eggs of domestic poultry and of wild-fowl. It is reported also that these expatriates in their foreign environment have become larger animals than their ancestors, and that their fur has greatly deteriorated in quality. The measures prescribed by the Agricultural Council of the Kingdom of Bohemia for their control are apparently without much success. This instance is a good illustration of the danger attending the introduction of an animal from its native habitat into a new region.

THE WOODRAT (Neotoma albigula and its relatives)

(*For illustration, see page 424*)

In the East known as woodrats, in the West, where much more numerous and better known, these animals are called "mountain rats" or "trade rats." Despite a certain superficial resemblance in size and appearance, woodrats are not related to those exotic parasites, the house rats, with coarse hair and bare tails, but are far more attractive and handsome animals, clothed in fine soft fur, delicately colored above in soft shades of gray, buffy, or ferruginous, while below they are usually snowy white or buffy. The tail is fully haired and in some species almost as broad and bushy as that of a squirrel. Their prominent black eyes and large ears give them an air of vivacious intelligence which their habits appear to confirm.

Woodrats are peculiar to North America, where they occur from Pennsylvania and Illinois to the Gulf coast, spreading thence to the Pacific and as far north as the headwaters of the Yukon, and south through Mexico and Central America to Nicaragua. They are not plentiful in the southern Mississippi Valley and eastward, where they live among cliffs and broken ledges of rock in the deciduous forests, and well deserve their common name. In this region their presence is rarely suspected except by hunters or others familiar with woodland life.

Far more numerous and widely known in the Western States and throughout most of Mexico, they have adapted themselves to life under every climatic condition, from the most sun-scorched deserts of the southwest and the splendid redwood forests of the humid coastal region in northern California to the tropical lowlands farther south.

They live nearly everywhere on the mountain slopes, even to timber-line at 13,800 feet on Mount Orizaba. They thrive in an extraordinary variety of situations, not only where they may find shelter among rocks, but also where they must seek safety in nests made on the surface of the ground or in burrows dug by themselves. They are prolific animals and each year have several litters containing from two to five young.

The presence of woodrats is generally indicated by accumulations of odds and ends filling the crevices of the rocks about their retreats or piled about the entrances of their burrows, such accumulations including small sticks, pieces of bark, leaves, cactus burrs, bones, stones, and any other small objects which may be found in the vicinity.

Sometimes these piles of fragments seem to be made merely for amusement or to work off surplus energy, as they form useless gatherings, such as heaps of small stones, frequently containing a bushel or more, piled on the rounded tops of small protruding boulders in open desert areas, or small heaps of sticks and other material scattered aimlessly about their haunts.

In the desert where cactuses of many kinds abound woodrats' nests are often made at the bases of these or other thorny plants and are covered with such a protective coating of cactus burrs as to deter the most insistent enemy. In the heavy forests of northern California woodrats build huge conical nests of sticks several feet in diameter on the ground, rising to a height of five feet or more.

In southern California and elsewhere some species make great nests of sticks eight to twenty feet from the ground in live oaks and other trees. The stick-pile nests on the ground usually have several entrances, with trails leading from them, and the underground burrows usually have two or more openings.

As may be surmised from their habits, woodrats are skillful climbers, both in trees and on

the rough rock walls of the cliffs they inhabit. Their only notes appear to be shrill squeaks and squeals when quarreling among themselves at night. They also express annoyance or alarm by a rapid drumming on the ground with their hind feet, just as is done by some of the hares and rabbits.

On Santa Margarita Island, in Lower California, I found the most curiously located habitations of these animals I have seen, the bulky stick nests being placed well back in the midst of a mangrove thicket growing in a tidal lagoon. At high tide the mangroves were isolated from shore by several rods of water, so that only at low tide were the rats able to go ashore. In going back and forth they followed certain lines of nearly horizontal mangrove stems, the discoloration on the bark plainly indicating the routes which finally led to dry land by little trampled roads across the muddy ground bordering the shore.

Back a little way from shore others of the same species were living in burrows guarded by orthodox stick and trash-pile nests among the cactuses.

Woodrats, especially in northern localities, gather stores of pinyon or other nuts, potatoes, corn, and any other non-perishable food available to meet the season of storms and scarcity, concealing these supplies in cavities in the nests either above or below the ground. They eat many kinds of fruits, seeds, leaves, and other parts of plants, sometimes including bark of shrubs or small trees and even cactus pads.

As a rule each nest is occupied by a single rat, but sometimes several may be found in one, and the well-worn trails that so often connect the entrances of neighboring nests bear evidence that woodrats have a social disposition. In most localities woodrats are distributed sparingly, but occasionally become so abundant in favorable places on brushy plains that colonies containing hundreds of nests may be found in limited areas. They sometimes become so plentiful about ranches as to make serious inroads on grain and other crops. They also give the Forest Service much trouble by digging up the pine seeds planted in their great reforesting nurseries.

Woodrats are mainly nocturnal in habits and appear to be extremely active throughout the night. Each morning in the vicinity of their nests the light soil shows a multitude of tracks, and in places I have seen little roads in the sand several hundred yards long which they had made by repeated trips to a feeding ground.

No sooner is a cabin built in the mountains than they move in and establish themselves under the floor, or locate a nest near by and use the house as their nocturnal resort. Throughout the night the patter of their busy feet may be heard as they race about on the floor or rustle about the roof, and often over the sleeping forms of their unwilling hosts.

Their activities are sources of mingled amusement and vexation. Small, loose articles, including table knives, forks, and spoons, vanish and all manner of trash, including horse droppings, are brought in, thus establishing their title to the cognomen of "trade rats." If the owner of a cabin leaves it for a few days, he may find on his return that the rats have taken possession and during his absence have tried to fill it with trash of all kinds, in order to make a comfortable home for themselves.

At one cabin in the mountains of New Mexico where I lived one summer several mountain rats made free of the place and at night persistently tried to add our shoes to their nest under the floor. An hour or so after retiring we would hear our shoes scrape slowly across the floor, and in the morning they would be found stuck toe down in the broad crack where the floor ended near the wall. In the woodrat country when small articles are missed from camp it is always worth the trouble to investigate the nearest rats' nests.

Woodrats are plentiful on the Mexican tableland, making their nests under cactuses or thorny agaves, where they are persistently hunted as game by the natives, who prize them as a special delicacy. I saw them regularly sold in the markets of the cities of San Luis Potosi and Aguas Calientes, where the method of marketing them was unique. As soon as they were dug from their nests, their lower incisors were broken off close to the jaw to render them powerless to bite, and then the rats were placed alive in a strong sack and carried to town.

The vendor would sit on a curb at the market and either kill and dress them there or shout his wares by telling every one who passed that he had "country rats; very delicious; live ones; fat ones; very delicious; very cheap." The natives all praised their delicate flavor and one I had served me as a special courtesy was really good, tasting like young rabbit.

THE HARVEST MOUSE (Reithrodontomys megalotis and its relatives)

(*For illustration, see page 425*)

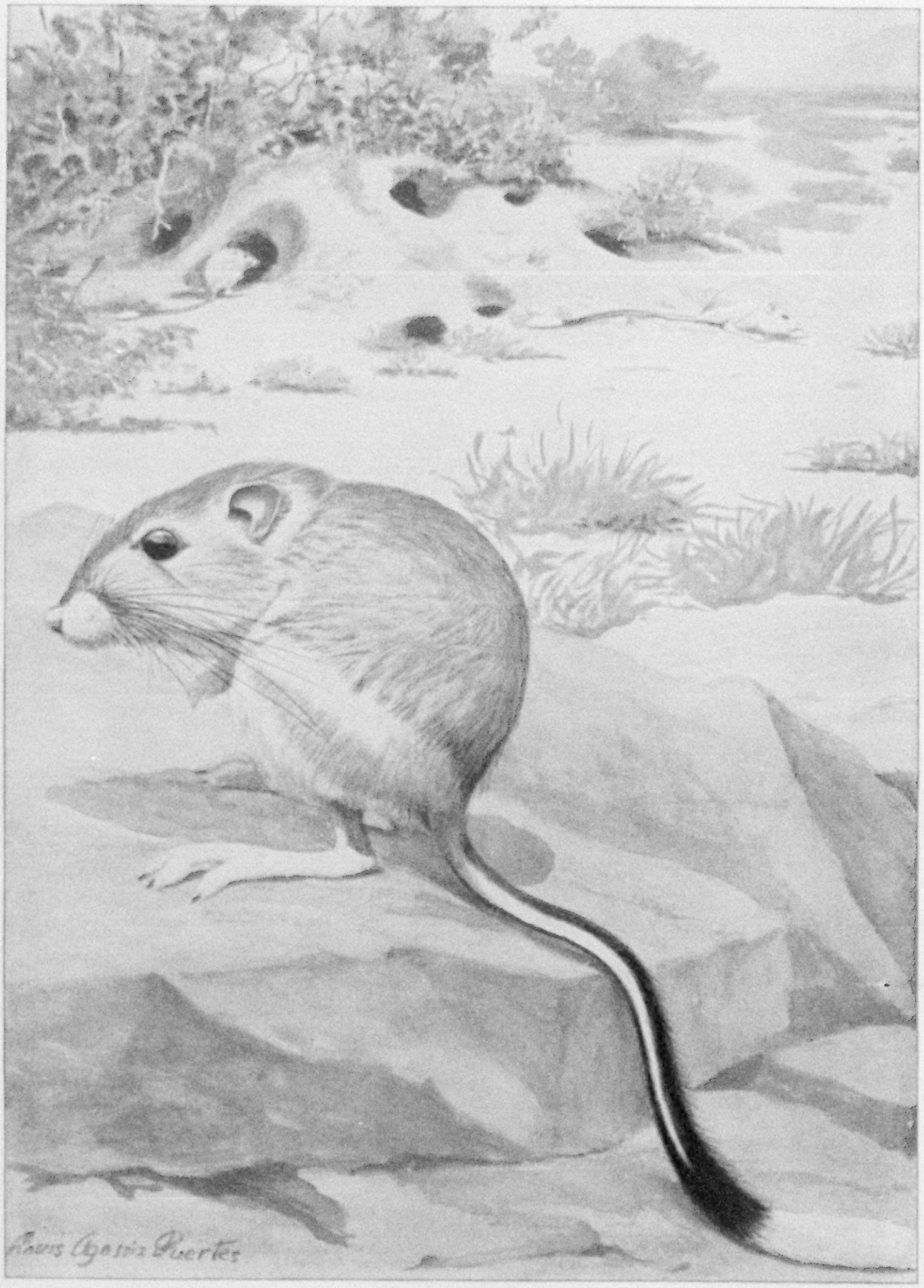
In size, proportions, and color the harvest mice, of all our American species, most closely resembles the common house mouse. Many of them are decidedly smaller than that animal and they rarely, if ever, exceed it in size. They may be distinguished from the house mouse by their browner colors, more hairy tail and especially by a little groove which extends down the front of each upper incisor.

The mice of this group include many species and have a wide distribution ranging from Virginia, in the eastern United States, to the Pacific, and from North Dakota, Montana, and Washington southward through Mexico and Central America to northern South America.

They reach their greatest development in number and diversity of species in the region about the southern end of the Mexican tableland, where I have caught them from the tropical lowlands, near sea level, up to an altitude of 13,500 feet, at timber-line, on Mount Iztaccihuatl.

These delicately proportioned and graceful little beasts are habitants of grassy, weed-

XUM

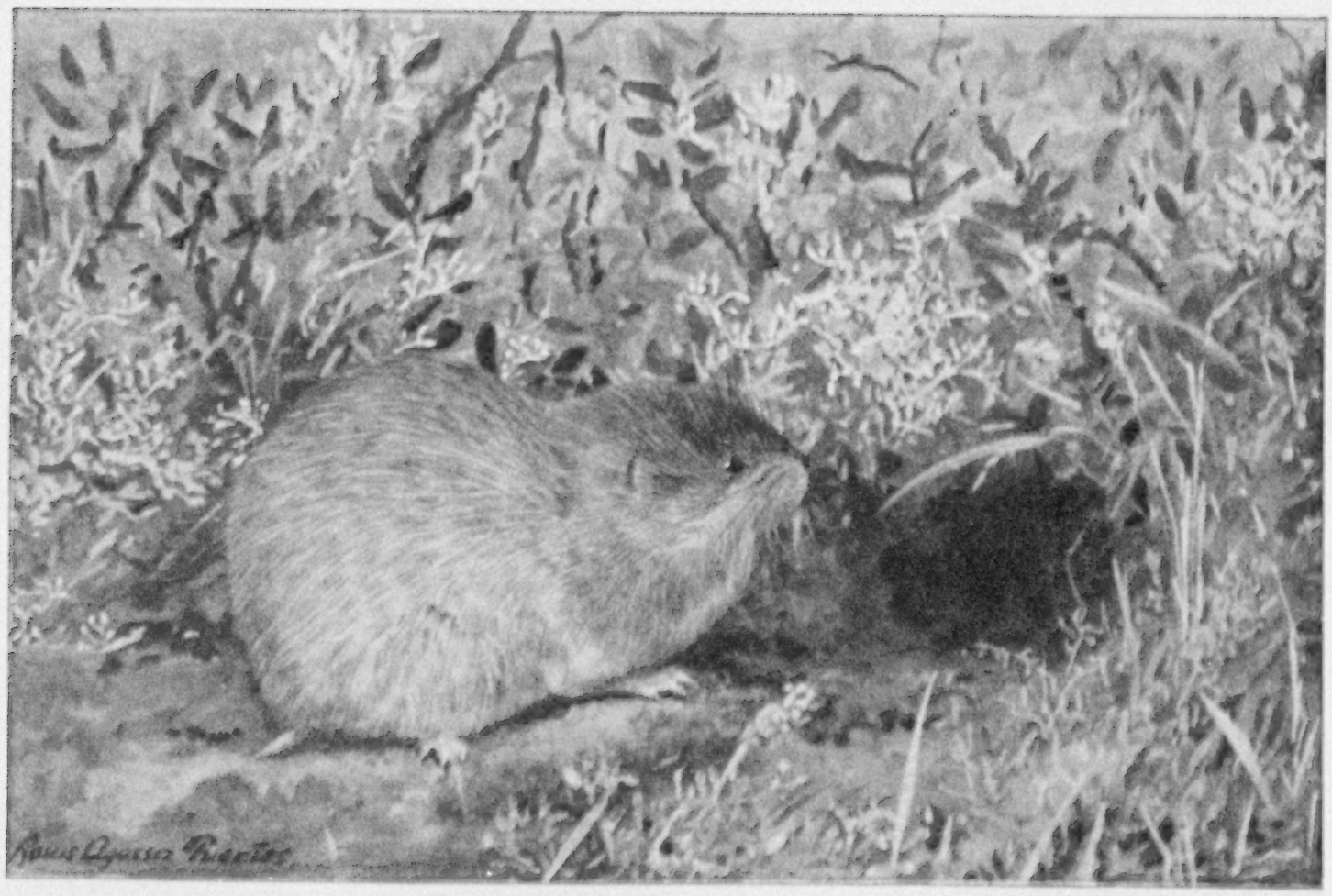


KANGAROO RAT
Dipodomys spectabilis

BANDED LEMMING (*Dicrostonyx nelsoni*)

Summer

Winter



BROWN LEMMING
Lemmus alascensis

XUM

grown, and brushy locations, mainly in the open country. They are equally at home, however, in the beautiful grassy open forests of oak, pine, and firs which clothe the slopes of the great continental mountain system of Mexico and Central America.

In general they prefer comparatively dry situations, if there is sufficient moisture to produce the needed vegetation, but some species inhabit swamps and even salt and fresh water marshes. Although as a rule not very numerous, at times they are very abundant and make well-worn trails through the small vegetation in their haunts. They are active throughout the year, and in the North, like some other mice, burrow through the winter snows along the surface of the ground in search of food.

So far as man is concerned, most of the harvest mice are among the least offensive of mammals. There are exceptions, however, and, although they rarely approach habitations and as a rule take but slight toll from grain fields and meadows, yet in some areas they become so numerous as to do considerable damage.

Their food includes a great variety of seeds, small fruits and succulent matter mainly from wild plants of no economic value. They lay up stores of seeds in their nests and in little special storage places for severe or inclement weather.

Some of the species dig burrows in the ground where their nests are hidden. Most of them, however, build globular nests of grass and other vegetable matter several inches in diameter in dense grass close to the ground, or up in the midst of rank growths of weeds, or even as high as eight or ten feet from the ground in bushes and low trees.

Sometimes they take possession of convenient sites already provided, such as old woodpecker holes, cavities in fence posts, knot holes, and deserted birds' nests, including the nests of the cactus wren and orchard oriole, which they remodel to suit themselves. Their nests are lined with fine downy material such as the pappus of the milkweed or the cattail flag, and have from one to three small openings usually located on the underside. In these neat homes they have several litters of from one to seven young each year.

Some of their bush nests three or four feet from the ground were found when I was hunting on El Mirador coffee plantation in Vera Cruz. Often on approaching them, the single occupant would dive headlong into the grassy cover below and disappear. But sometimes when disturbed they would come out and run about through the tops of the bushes, leaping from branch to branch with all the agility and graceful abandon of pigmy squirrels. Several times they were seen to stop and sit crosswise on the branches with their tails hanging straight down. When they move about among the branches they sometimes coil the tail around the twig as an opossum might, to give them a more certain hold.

While harvest mice may be seen at their nests by day, they are mainly crepuscular and nocturnal, and so retiring in habits that their presence may be entirely overlooked unless special search is made to locate them. Where found their pretty ways well repay the observer who has the patience to spend a little time with them.

THE GRASSHOPPER MOUSE (Onychomys leucogaster and its relatives)

(For illustration, see page 425)

The grasshopper mice are notable for the delicate coloring and velvety quality of their fur. While closely resembling some of the white-footed mice, they may readily be distinguished from them by more robust form, short, thick tail, and the character of the fur.

Only two species, each with numerous geographic races, are known and both are peculiar to North America. Characteristic animals of the arid and semi-arid treeless plains, plateaus, and foothills of the West, their known range extends from Minnesota and Kansas west to the Cascades and to the Pacific coast of southern California, and in the North, from the plains of the Saskatchewan southward to San Luis Potosi, on the tableland of Mexico.

Some races live on the grassy plains west of the Mississippi, but the majority prefer the looser soil and sandy areas of the more arid Great Basin and the even more desert Southwest, where the vegetation is characterized by a scattered growth of woody plants, including many species of cactuses, yuccas, agaves, sagebrush, greasewood, mesquites, acacias, and other picturesque types.

Like other small mammals of the open plains, the grasshopper mice live in burrows. When opportunity offers they evade the labor of digging these for themselves by occupying the deserted holes of mice, kangaroo rats, ground squirrels, prairie dogs, badgers, and other animals. In these retreats they have nests of soft vegetable matter and each season bring forth several litters containing from two to six young.

They are active throughout the year, but nothing appears to be known as to the kind and amount of stores they lay up for winter use. As many live far enough north to experience a long period of cold, with snow covering the earth, there is little doubt that they exercise the same provision in providing stores to meet the need as do many other small mammals.

Many species of mice eat insects or meat and even on occasion devour one of their own kind. The grasshopper mice go far beyond this and are often not only as fierce flesh eaters as real carnivores, but make their diet, at least during the summer season, mainly of insects and other small invertebrates. Their bill of fare includes a miscellaneous assortment of several species of mice, including their own kind caught in traps, small dead birds, lizards, frogs, cutworms, scorpions, mole crickets, ordinary crickets, grasshoppers, moths, flies, and beetles, including the "potato bug."

XUM

In addition they eat many kinds of seeds, fruit, and other vegetable matter. Where obtainable, grasshoppers are one of their favorite foods, and from this they receive their common name. In Colorado, from their fondness for scorpions, they are sometimes called "scorpion mice."

Vernon Bailey's observations of a grasshopper mouse he had in captivity are illuminating as to their habits, and indicate that their presence in numbers about cultivated land must be of distinct economic value. When undisturbed and well fed the captive was entirely nocturnal, sleeping all day and becoming very active at night. While usually quiet, sometimes jumping with all his force he tried furiously to escape from his small prison box. His favorite food consisted of crickets, grasshoppers ranking next. Among other things he ate were a black beetle, ladybirds, a potato beetle, spiders, bugs, and dragon flies.

In feeding he sat upright on his haunches and held the insects in his front paws, eating them head first. Large grasshoppers, their tails resting on the ground, were held head up by a paw on each shoulder. A grasshopper would sometimes kick so vigorously as to tip the mouse off its balance, but was never relinquished until decapitated.

The mouse promptly killed and ate a small frog placed in his box and was expert at catching flies. He ate many kinds of insects, including a live wasp, but appeared terror-stricken if a few ants were put in with him. When a dozen or more crickets and grasshoppers were put into his box at the same time he at once proceeded to bite off all their heads before beginning to feast upon them.

A dead white-footed mouse was dropped in and "he pounced upon it like a cat, caught it by the side of the head near the ear, and began biting it with all the ferocity of a coon dog." The bones could be heard cracking and after the little beast appeared satisfied that his prey was really dead he ceased worrying it and an examination showed that he had bitten through its skull deep into the brain. Afterward he tore off and ate fragments of flesh from its head, neck, and shoulders. The ferocious certainty with which he seized the white-footed mouse by the head and bit through its skull indicated that in relation to small mammals he, probably like all his kind, had the predatory instincts and habits of the carnivores.

One morning he ate 12 crickets and a spider in seven minutes and during a single day devoured 53 insects—2 beetles, 8 grasshoppers, 28 crickets, and 15 flies—and appeared ready to take more.

Oddly enough, this grasshopper mouse, so fierce toward small game, never offered to bite when captured or when handled freely, but continued throughout his captivity to have the same friendly confidence in his captor. Others caught in various parts of their range have shown the same characteristics.

At night, especially early in the evening, grasshopper mice utter a fine shrill whistling call note. This habit appears peculiar to them among all the mice and may be likened to that of many of the large beasts of prey in uttering their hunting call as they sally forth for the night's foray.

THE WHITE-FOOTED MOUSE (Peromyscus leucopus and its relatives)

(*For illustration, see page 428*)

Few of our smaller wild mammals are so generally known as the white-footed mice. Usually a little larger and proportionately shorter bodied than the house mice, they may at once be distinguished from them by the contrast between the delicate shades of fawn color, brown, or gray of the upper parts of the body, and the snowy white feet and under parts. Like other members of the genus, they have cheek pouches inside the mouth for gathering and carrying food to their stores.

Their exceedingly quick and graceful movements and their beauty of form and color would make them generally attractive were it not for the prejudice against all their kind resulting from the offensive ways of the house mouse.

Mice of the genus Peromyscus, to which the white-footed mice belong, are peculiar to North and South America and include more species and geographic races than any other American genus of mammals. The white-footed mice are limited to North America. Readily responsive to the influences of environment, they have developed numerous species and a large number of geographic races.

These are spread over most of the continent from the northern limit of trees to the tropical shores of Yucatan. One form has the distinction of living up to an altitude of from 15,000 to 16,000 feet on Mount Orizaba, Mexico, where I found its tracks in the volcanic ashes at the extreme limit of vegetation. This is the highest record for any North American mammal.

White-footed mice are active throughout the year and thrive in every variety of situation. In winter from the Northern States to the Arctic circle the snowshoer traversing the forest will note their lace-work patterns of tiny tracks leading across the snow from log to log or tree to tree. At sunrise on the southwestern deserts their tracks made during the night often form a fine network in the dust, but disappear with the first breath of the morning breeze.

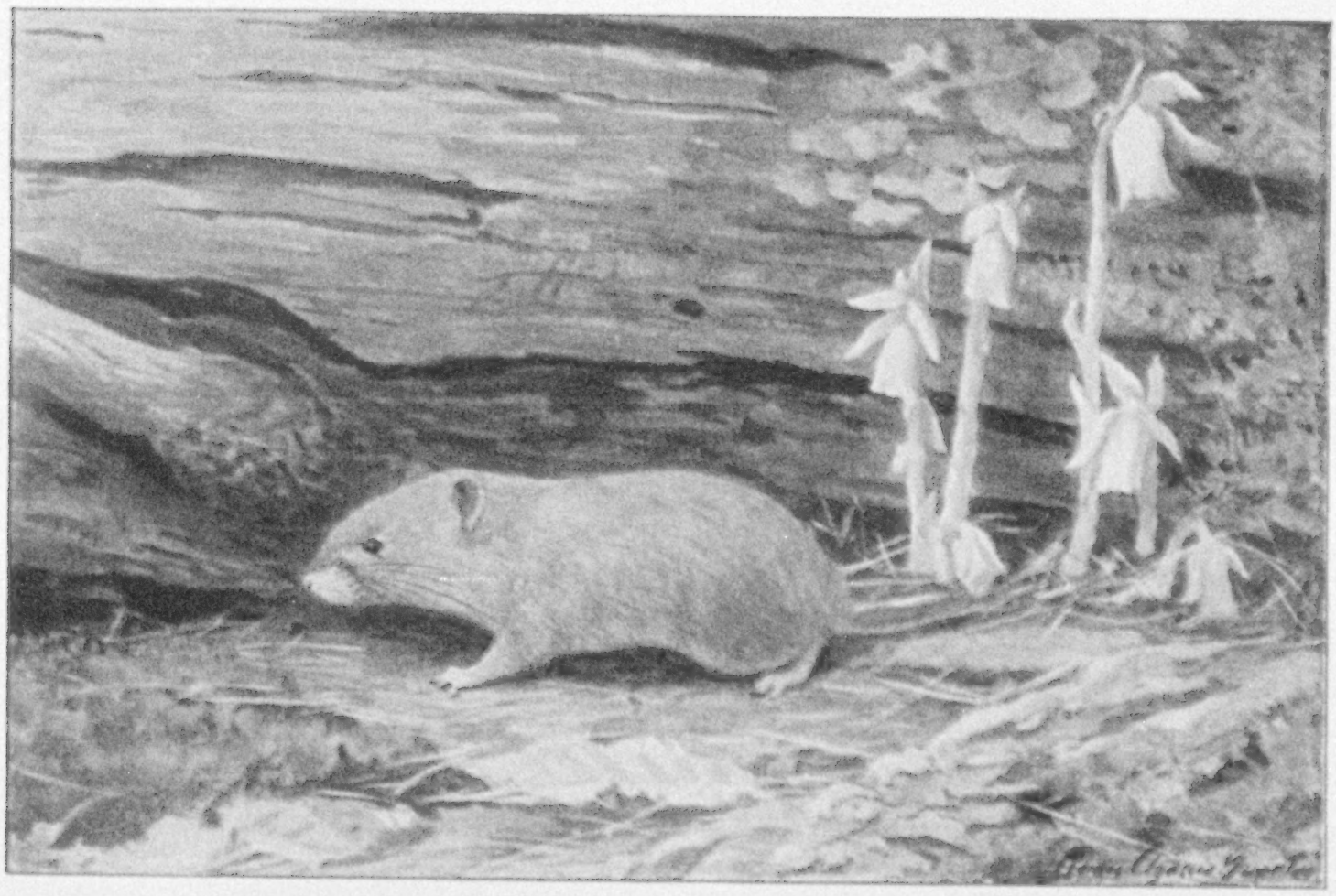
They not only live everywhere in the wilderness, but are prompt to swarm about camps and other habitations, where they make free with the food supplies. Few frequenters of forest camps in the Northern States and Canada have failed to see the bright eyes of these pretty little animals peering at them from some crevice, or the mice scurrying along the log wall like little squirrels.

They are industrious workers and once in a cabin quickly locate some cozy nook in a box or other secluded place to construct a warm nest of any soft fibrous vegetable material

XUM

FIELD, or MEADOW, MOUSE
Microtus pennsylvanicus

PINE MOUSE
Pitymys pinetorum



RED-BACKED MOUSE
Evotomys gapperi

RUFOUS TREE MOUSE
Phenacomys longicaudus

available. This completed, they set busily at work nights to raid the food supply of the owner and hide it in suitable storage places, such as a crevice among boxes, an old shoe or a pocket in a garment hung on the wall. Their depredations usually cause so much exasperation that the camper overlooks the grace and beauty of his visitors and makes every effort to destroy them. If the occupants of such camps would keep their supplies in mouse-proof containers and would then feed their woodland friends, they would find them quickly responsive and most attractive guests.

In their native haunts these mice have habits varying with varying conditions. On brushy plains they burrow in the ground, while in the woods they sometimes burrow under rocks, stumps, and logs, or live in hollows in stumps and trees. As nimble in climbing as squirrels, many live in hollow trees sometimes more than fifty feet above the ground.

That our inability to see at night prevents more than an occasional glimpse at the doings of the small animals which often swarm all about us was impressed on me at one of my camps in the desert of Lower California. My blankets were spread under a small leafless tree growing near the base of a rocky ledge, in the crevices of which many relatives of the white-footed mice were living. The first morning in camp I awoke as the sky began to pale and color with the approach of day. The dry branches of the tree a few feet overhead became sharply silhouetted against the sky, revealing several of the mice running up and down them and leaping from twig to twig with all the active grace of tiny squirrels.

The mice appeared to be racing about in pure playful enjoyment of the exercise, and when the light had increased sufficiently to render objects on the ground distinct they suddenly ran down the tree trunk and vanished in a crevice in the rocks. This game was repeated on several succeeding mornings and is no doubt commonly indulged in where conditions are favorable.

White-footed mice feed mainly on many kinds of seeds and nuts and vary this diet with snails, insects, and sometimes with the flesh of dead birds or other mice. As they do not hibernate they lay up abundant stores of grain and seeds of many kinds in addition to a variety of nuts, as acorns, beech nuts, pine nuts, maple seeds, and others, according to the locality. The stores are hidden in hollows in logs, stumps, trees, or in the ground. When in captivity they have shown themselves expert in catching flies, sometimes capturing them with their teeth and again with their front paws used with all the dexterity of little hands.

Several litters of young containing from three to seven each are born, the first usually appearing in spring and the last in fall. The young are blind and helpless at birth, and in this condition cling so tenaciously to the mother's teats that when she is frightened from the nest they are often carried off attached to her.

Some individuals at least of the white-footed mice, like others of the genus Peromyscus, are known to have a prolonged and musical song. It is a fine warbling ditty, a little like the song of a canary. A number of good observers have recorded these performances, but they appear to be so infrequent that most people with woodland experience have never heard them.

The lives of these mice are passed in constant fear of a host of enemies. Hawks and owls, bluejays, and shrikes in the bird world are ever on the alert to capture them, while skunks, weasels, minks, foxes, and snakes persistently seek them in their retreats.

THE BEACH MOUSE (Peromyscus polionotus niveiventris and its relatives)

(*For illustration, see page 428*)

The beach mouse is a beautiful, velvety-furred little creature about the size of a house mouse and one of the smallest species of the genus Peromyscus. Its back is colored with delicate shades of pale vinaceous-buffy and its underparts, including the feet, are snowy white.

The species *Peromyscus polionotus*, of which the beach mouse is one of several geographic races, or subspecies, occupies a comparatively restricted range in the lowland region of Alabama and Georgia and thence through a large part of Florida.

It presents an unusually convincing illustration of the influence of changing environment upon the physical characters of animals. Among the cotton fields of Alabama and Georgia *Peromyscus polionotus* is rather dark grayish brown, but on the lighter-colored soil of Florida the color responds and becomes paler in perfect correspondence with the change in soil until the white sand-dunes and beaches of the coast are reached. There, in strong contrast with the color of the northern members of the species, it is so modified that the pale representatives of this area are recognized under the name *niveiventris*, as a geographic race, or subspecies.

Changes in environment affect both great and small mammals in a variety of ways, sometimes in shades of color, sometimes in relative size, and sometimes in proportions. Exceptions to the rule are to be found, however, and some species of mammals have a wide range under a great variety of conditions, with scarcely an appreciable sign of variation.

The beach mouse is abundant on the sand-dunes and beaches of peninsular Florida, especially from Palm Beach to Mosquito Inlet, wherever there is a growth of sea oats (*Uniola*), which appears to be its principal food plant. It is a nocturnal animal and its nightly activities may be read, early in the morning, from the multitude of tiny tracks which lead in all directions and often form a network on the sand. A single track sometimes extends for a hundred yards or more from a burrow, and with all its windings may aggregate several hundred yards of travel, showing the activity of this small worker during many hours.

Tracks are most plentiful immediately about

growths of sea oats, patches of saw palmetto, or scrubby bushes. The homes of these mice are usually in short burrows sheltered by growing vegetation or under fallen palm fronds.

As in the case of many of our mammals, we have scanty information concerning the life of these attractive little animals, and it is suggested that here lies a pleasant subject for investigation by some nature lover wintering in Florida.

THE BIG-EARED ROCK MOUSE (Peromyscus truei and its relatives)

(*For illustration, see page 429*)

The numerous species of mice of the genus Peromyscus in North America include a great variety of little beasts, many of which are distinguished by beauty of form and color. One of the most striking and picturesque individualities among these is found in the big-eared rock mouse, which is characterized by its great ears, a thick, soft coat of buffy brown fur, and a long, well-haired tail. In size it exceeds the common house mouse and even the white-footed mice which share its haunts.

This rock mouse is indigenous to the mountainous regions of the West, from Colorado and New Mexico to the Pacific and south to the Cape Region of Lower California, and down the Sierra Madre of Mexico to Oaxaca. Within this area it divides into several not very strongly marked geographic races.

As implied by its common name, it is a characteristic dweller among cliffs and ledges along the mountain slopes or rocky canyon walls, where it occupies the many crevices and little caves. In California it ranges from near sea-level up on the mountains to above 10,000 feet altitude. Although showing a distinct preference for rocky places, when available, some races of this mouse adapt themselves to other conditions and may be found on brush-grown flats, where they live in brush heaps, old wood-rat nests, and similar shelter.

That they make their homes in places other than cliffs in New Mexico was evidenced by a thick, soft nest made almost entirely of wool, found in a hollow juniper. They have several litters of from two to six young each year, the breeding period extending from spring to fall.

In Arizona and New Mexico I found the rock mouse most numerous in the belt of junipers and pinyons and in the adjacent yellow-pine forest. The crevices of cliffs about the Moki and Zuni Indian pueblos and in all the rocky wilderness of that region, including the Grand Canyon, are abundantly populated with them.

They search every nook about their haunts and often visit cabins or temporary camps for food, but do not usually take up their abode in them as do the white-footed mice. When foraging their movements are quick, and when startled they make surprisingly long leaps. Like others of their kind, they eat a great variety of seeds and small nuts, quantities of which they lay up in winter stores. Pinyon nuts, and especially juniper seeds, are their favorite food.

While of nocturnal habits, rock mice at times wander forth in sheltered spots by day, and on the few occasions I have seen them I have been delighted with their grace and beauty, their great ears and prominent shining black eyes lending them an attractive air of alert intelligence.

Throughout their lives they are in deadly peril from predatory foes. Hawks and owls glide shadowlike along the faces of their rocky homes ready to pick them up whenever they venture into open view, while bobcats, skunks, and weasels prowl about by night hunting their furry victims.

THE BROWN RAT (Rattus norvegicus and its relatives)

(*For illustration, see page 429*)

It is safe to assume that few readers need an introduction to that world-wide pest variously known as the brown rat, house rat, wharf rat, or Norway rat. Two European relatives, the black rat and the roof rat, preceded the brown rat to the New World and became widely distributed. They resemble the brown rat, but are much smaller and are soon killed, driven away, or reduced to a secondary status by their larger and fiercer cousin, which averages about sixteen inches in length, although large individuals attain a length of more than twenty inches and a weight of more than two pounds. The black rat has nearly disappeared from most of its former haunts in the United States and the roof rat is mainly restricted to southern localities with a mild climate.

Neither the brown, black, nor roof rat has any near relatives among native rats of America, and all may be distinguished from our native animals by their coarser hair and long, naked tails.

The brown rat is believed to have first invaded Europe from Asia in 1727, when hordes of them swam the Volga River, and about the same year it arrived in England on ships from the Orient. Since then, traveling by ships and by inland commercial routes, it has spread to nearly all parts of the globe. In America it is now established in human abodes throughout the length and breadth of the continents from Greenland to Patagonia.

Wherever it goes the fierce and aggressive spirit with which it is endowed qualifies the brown rat more than to hold its own against all rivals, while its mental adroitness and its fecundity have largely nullified the constant warfare being waged against it by all mankind. Not content with infesting ships, dwellings, stores, warehouses, and even the refrigerating rooms of cold-storage plants in many areas, it has established itself as an extremely destructive pest in the open fields.

In towns it hides among stored merchandise, in the hollow walls of buildings, in sewers and other underground passages, or, as in the fields,

XUM

MUSKRAT
Fiber zibethicus

WOOD RAT
Neotoma albigula

HARVEST MOUSE
Reithrodontomys megalotis

GRASSHOPPER MOUSE
Onychomys leucogaster

in burrows which it digs in the ground. Its nests are soft, warm masses of fibrous material which is secured by raids on any available supply of cotton, wool, or fabrics, which they cut into shreds for the purpose.

In these retreats it has several litters a year, averaging about ten young, but exceptional cases of more than twenty young have been recorded. The young begin to breed when less than six months old. The size and number of litters increase with the food supply, and under favorable conditions rats soon become intolerable pests.

In Jamaica and the Hawaiian Islands rats became so numerous that sugar-cane and other plantations were at one time threatened with complete destruction. To save the crops the mongoose was introduced, but after checking the rats in Jamaica these curious little mammals in turn became a pest which it appears hopeless to control.

In the Hawaiian Islands the mongoose reduced the number of rats, but the survivors promptly took up their abodes in the tree tops, where they now live as completely arboreal lives as squirrels, safe from their ground-inhabiting enemy.

During a two weeks' campaign against rats in the sewers of Paris 600,000 were killed, and on a rice plantation of about 1,200 acres in Georgia 30,000 were destroyed in one season. In Illinois 3,435 were killed on a farm in one month.

One of the most curious chapters in the life of this hardy beast is now developing in the far island of South Georgia, on the border of the Antarctic, east of Cape Horn. On this island, which has a cold and stormy summer and nine months of rigorous winter, several whaling stations have been established. For years great numbers of whale carcasses have drifted ashore each season and, half rotting, half refrigerated, have furnished a never-failing food supply for brown rats that have landed from the ships. With such abundant food they are reported to have increased until they now exist there literally in millions. They make their nests in the tussocks of grass and peat and swarm along well-marked trails they have made on the mountain sides.

In the trenches along the battle front in France they have become extremely abundant and troublesome, and in England have multiplied until the Board of Agriculture is recommending efforts to destroy them as a menace to the public welfare through their waste of food supplies.

On farms, in addition to destroying growing and stored crops, they kill great numbers of young chickens, turkeys, and other poultry, and create havoc with such ground-frequenting game as pheasants. At all times brown rats are more or less carnivorous, and when several are confined in a cage the stronger will soon kill and devour the weaker.

In city department stores and large hotels they often cause thousands of dollars damage yearly in single establishments. An English organization for their destruction estimated in 1908 that, outside the towns and shipping, in Great Britain and Ireland they caused annual losses of about $73,000,000.

When there is a sudden diminution in the food supply, an abundance of which has caused a great increase in the rat population, the rats migrate into other districts, sometimes in enormous numbers. These migrations usually occur at night, and many are matters of history in Europe and in the United States.

A witness of one of these migrations in Illinois in 1903 reported that one moonlight night as he was passing along the roads he heard a rustling in a field near by and soon saw crossing the road in front of him a multitude of rats extending as far as he could see. The following year the invaders became a plague in that district. At times of food scarcity rats become extremely bold and aggressive. Without hesitation they swim streams encountered in their wanderings and at times will even attack man.

Owing to their great numbers, universal distribution, and destructiveness, brown rats are the worst mammal pest known to mankind. Through their habit of living in sewers, among the offal of slaughter-houses, and in garbage heaps, from which they invade dwellings and storehouses, they pollute and spoil even more foodstuffs than they eat.

In addition, they are known carriers of some of the worst and most dreaded diseases, as bubonic plague, trichinosis, and septic pneumonia; while there is little doubt that they spread scarlet fever, typhoid, diphtheria, and other contagious maladies. Bubonic plague is mainly dependent upon rats for its dissemination and has been carried by them to more than fifty countries, including the United States. In India more than two million people have died in one year from this rat-conveyed disease.

Although rats are abhorred by man, yet they have been for ages so closely associated with most of his activities that they have long had their place in Old World literature. Among other instances, many readers will recall Victor Hugo's gruesome account of Jean Valjean's fight with the rats in the sewers of Paris. In England and on the continent rat catching has been a regular trade and dogs have been specially bred for use in their pursuit.

Rats are loathsome vermin which civilized man should eliminate with the other evils of his semi-barbaric days which he is leaving behind. One might still wish that in many places a modern "Pied Piper of Hamelin" would appear and rid the people of these pests. This is not necessary, however, if the public will cease to take their presence as a matter of course. Their exclusion from buildings and destruction are merely matters of good housekeeping, both personal and communal.

Rats can be banished by removing or destroying trash heaps and similar harboring places and by the simple expedient of rat-proofing buildings, especially dwellings, granaries, warehouses, and other places where food supplies are stored.

These precautionary measures should be sup-

plemented by trapping or poisoning in open places. Campaigns of this kind can be fully successful only when engaged in by the community at large. The returns from the investment for such a purpose will be large, not only in the vast money values of property saved, but in the reduction of the death rate and in the great improvement of the public health.

THE HOUSE MOUSE (Mus musculus)

(*For illustration, see page 429*)

The familiar house mouse is of Old World origin and may be distinguished from most of our native mice by its proportionately slenderer body, long hairless tail, and the nearly uniform color on the upper and under parts of the body. Like the house rat, wandering an alien from its original home in Asia, and transported by ship and by inland commerce, it has gained permanent foothold and thrives in lands of the most diverse climatic conditions, except those of the frigid polar regions.

For centuries the house mouse has been parasitic about the habitations of man, and in many places in America has spread into the surrounding country, where it holds its own in the struggle for existence with many of our native species. It is probable that its ability to live in houses also infested by the fierce brown rat is due wholly to its agility, and to the small size, which enables it to retreat through crevices too small for the rat.

In buildings it hides its warm nests in obscure nooks and crannies, making them of scraps of wool, cotton, or other soft fibrous material, often cut from fabrics. Out in the fields, like any other hardy vagabond, it adapts itself to whatever cover may be available on the surface or in crevices and the deserted burrows of other mammals.

It has several litters of from four to nine young each year. The young are born blind, naked, and helpless, but are soon able to run about, often following the mother on her foraging expeditions. When a little more than half grown they usually scatter from the home nest and seek locations of their own.

Throughout most of its world-wide range the house mouse has the same general appearance, but in some localities the effect of changed environment is developing appreciable differences, which appear destined to result in marked geographic races. The representatives of these mice I caught in weedy fields on the coast of Chiapas, near the border of Guatemala, have an appreciable rusty shade on the back in place of the ordinary dull gray.

The success of both the house mouse and the house rat in establishing themselves so successfully in all parts of the world, in the face of the antagonism of mankind, affords marvelous examples of physical and mental adaptability not equaled elsewhere among mammals.

From early days the domestic mouse has been a familiar member of the household with people of all degree, and the housewife has had to match her wits against the cunning persistence of this small marauder in order to safeguard the family supplies of food and clothing.

Despite the antagonism excited by its destructive habits the mouse is so small and often so amusing in its ways that it has commonly been regarded with a half hostile, half friendly, interest. This is apparent by frequent references to it in proverbs, nursery rhymes, fables, and folklore, as well as in more serious literature.

Many cases of singing house mice have been recorded, their notes being a series of continuous musical chirps, trills, and warblings, rising and falling about an octave and slightly resembling the song of a canary. It has been claimed that this singing is due to an affection of the songster's breathing organs, but this can scarcely account for its being uttered at definite times and places and ceasing at the volition of the performer.

In one instance the song had been heard in a china closet and an observer sat by the open door to locate the singer. After patient waiting "a mouse peered out from behind the plates, climbed up a little way on the brackets, and after looking around several times, began to sing." This mouse continued to sing in the same place at intervals for several weeks and became accustomed to the presence of people during its performances; then it suddenly disappeared, probably a victim to one of the dangers which constantly beset its kind.

THE MOUNTAIN-BEAVER (Aplodontia rufa phaea and its relatives)

(*For illustration, see page 432*)

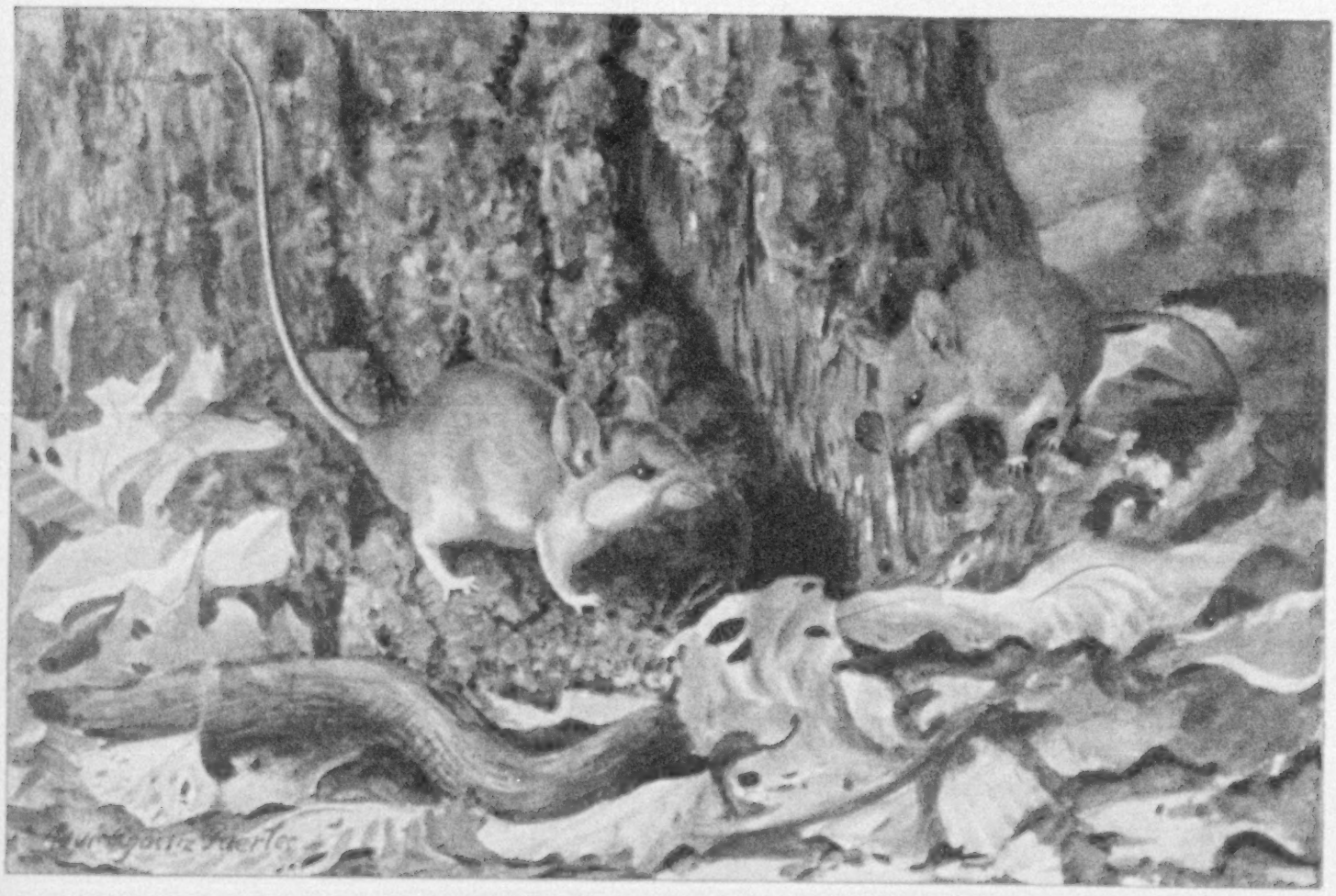
The first adventurous fur traders who penetrated the Oregon wilds found the Chinook Indians provided with robes made of skins of the mountain-beaver. From that time until recently but little accurate information has been available concerning the habits of this curious animal. Locally it is known by several other names, including "Sewellel," "mountain boomer," "boomer," and, in the Olympic mountains, "chehalis."

The genus of mountain-beavers contains only a single species with several subspecies, all having a close superficial likeness in size and form to a tailless muskrat, except for their coarse, harsh fur. It is an exclusively North American type and, aside from a remote relationship to the squirrel family, has no kin among living mammals. It appears to be a sole survivor from some former age. As with the pocket gophers, its mode of life has developed powerful muscles about the head, front legs, and forepart of the body.

The distribution of the mountain-beaver in Tertiary times extended through the Great Basin to North Dakota, but at present is closely restricted to the humid region between the crests of the Cascades and the Sierra Nevada and the Pacific coast, and from the lower Fraser River, British Columbia, south to the latitude of San Francisco Bay, California.

Within this superbly forested region this ani-

XUM



WHITE-FOOTED MOUSE (Adult and Young)
Peromyscus leucopus

BEACH MOUSE
Peromyscus polionotus niveiventris

BIG-EARED ROCK MOUSE
Peromyscus truei

BROWN RAT
Rattus norvegicus

HOUSE MOUSE
Mus musculus

XUM

nual delights in locations that are cool and oozing with water, where, under the dense shade of an almost tropical undergrowth of shrubs, ferns, and other herbage, it constructs numberless tunnels and trails. These are sometimes in flats, but much more often along canyons and mountain slopes, among willow, alder, aspen, or other thickets, or even in the heavy coniferous forest.

Veritable colonies inhabit certain areas and the ground is honeycombed with burrows six to eight inches in diameter and covered with a network of surface trails. The irregular branching tunnels are sometimes two or three hundred feet in length and have at frequent intervals side passages through which the earth mined in extending the burrow may be ejected in small dumps. The tunnels appear in a large measure built for the safety of the owner in traveling, since they repeatedly come to the surface at the end of a log, where an open, neatly kept trail extends under its shelter the entire length, the tunnel being resumed at the far end of the log.

All surface runways connecting tunnel entrances or leading through the thick surface vegetation are well kept and free of all obstructions. The ground in these haunts is commonly so saturated with water that the tunnels form drainage channels down which run little streams.

Nest chambers discovered by T. H. Scheffer in the Olympic Mountains were located in tunnels two feet underground. They were oval in form and one measured eighteen inches in horizontal diameter and seventeen in height. Here three storage chambers opened directly from the nest chamber, one of which contained two quarts or more of sections of fern roots, which had been kept so long they were spoiled, and another was partly filled with freshly cut leaves of nettles and twigs of cedar and fir. At the far end an opening dropped six inches into a small drainage basin partly filled with water, out of which led two passages. The roofs of the chambers were lined with a thin layer of clay, which appeared to have been packed in place by the owner.

In the upper and drier part of the nest, which was made of dried fronds of ferns, grasses, and small twigs, were found three young less than a week old, with coats of fine fur, but with eyes still closed. Like burrowing animals generally, the mountain-beaver is cleanly in its housekeeping, and offal, loose dirt, and debris of all kinds are pushed out by the forefeet and head to the dumps at the less-used openings.

In winter much of the mountain-beaver country is buried under several feet of snow, but this does not stop the activities of this hardy animal. Between the entrances to its burrows and out along the surface of the ground it tunnels through the snow in various directions in search of forage.

At this time it cuts twigs from bushes and gnaws the bark from the trunks and roots of the smaller trees, sometimes completely girdling and killing trees more than two feet in diameter. Its underground tunnels are also extended at this season, the soils being pushed up in dumps under the snow and parts of the snow tunnels are packed full of it for some distance, so that when the snow disappears the curious earth-forms remain like those of the pocket gopher.

The mountain-beaver lives a monotonous existence and correspondingly lacks the mental vivacity of many other species which have a greater freedom of movement. When one is caught it shows little fear, but struggles to escape, growling, clattering its teeth, and biting viciously at anything within reach. Its desire for food, however, appears to control its emotions, and very soon after being captured it will eat any green vegetation offered, as unconcernedly as though free.

That the mountain-beaver possesses social instincts is evident, as a pair is often found occupying one set of tunnels, and in many favorable places a number will have their burrows closely grouped and connected with a network of communicating surface trails.

Although mainly nocturnal, the animals are active early in the morning and late in the afternoon, as well as throughout dark days. Those kept in captivity would show periods of restless activity at night and have alternating periods of sleep and wakefulness during the day. Sometimes they would sleep coiled with the head turned under the body and again flat on their backs. During these periods their sleep is often so profound that they may be handled without being awakened.

One captive animal is reported to have uttered a curious quavering note resembling that of a screech-owl. They have a strong musky odor, which is very evident when they are first caught, and which is frequently apparent about the burrows.

Careful and repeated efforts to keep these animals in captivity under as near normal conditions as possible in regard to food and surroundings in the vicinity of where they were captured have, up to the present time, resulted in failure. In every case the animals failed to thrive and soon died.

The mating occurs about the middle of March, and a month later litters of two or three young are born. The young grow slowly, not attaining full size for a year or more, and do not breed until the second year, but they leave the shelter of the home nest and scatter to occupy burrows of their own at the end of the first two or three months.

The mountain-beaver feeds upon nearly all small vegetation growing in its haunts, including, in addition to small herbage, shrubs, the bark of trees and bushes, ferns, and fern roots. More than thirty species of native plants have been found among its "hay" piles at the mouths of burrows. Since its country has become increasingly occupied by farmers, it has developed a fondness for cultivated crops that, in many places, is rendering it a pest. It appears to have a special taste for cabbage, potato, and onion tops, and other garden produce.

When gathering its food it sits up squirrel-

XUM

like and grasps the plant stem with one hand, a long projecting tubercle on the "heel" of the hand opposing the fingers like a thumb and giving a good grasp, so that it can pull plants down to be bitten off with the sharp front teeth. Sometimes it climbs up a few feet into a bush or small branching tree after succulent shoots.

The mountain-beaver has the interesting habit of gathering stores of green plant food much like that of the cony on the mountain tops, but appears to be more methodical in its ways, gathering the stems of such plants as grasses, ferns, and lupins, as well as twigs of various bushes and carrying them in bundles as large as can be held in the mouth, the butts of the stems neatly laid together. These little bundles of "hay" are placed side by side about the entrances of the burrows, with the butts all parallel on sticks or other support to keep them as clear as possible from the ground. They are left thus for a day or more to cure before being carried into the subterranean store-rooms.

Chief among the four-footed enemies of the mountain-beaver are the fisher and bobcat, and an eagle has been seen keeping close watch at the entrance of their burrows.

THE COMMON WOODCHUCK, OR AMERICAN MARMOT (Marmota monax and its relatives)

(For illustration, see page 432)

The woodchuck or "groundhog" is a typical marmot, with coarse hair, heavy body, short neck, short, bushy tail, powerful legs, and feet armed with strong claws for digging. When fully grown it averages about ten pounds in weight. Its usual color is a grizzled brown, but in some districts black, or melanistic, individuals are not uncommon.

Marmots are common to Europe, Asia, and North America. The group contains many species and geographic races varying in size and color. The Alpine marmot of Europe is probably the most familiar of the Old World species and the woodchuck the best known in America.

North America contains several species of marmots, their joint territory extending from coast to coast over the northern parts of the continent and from southern Labrador, the southern shores of Hudson Bay and Great Slave Lake, and central Alaska southward to northern Alabama, and along the high mountains to New Mexico and the southern Sierra Nevada of California. The common woodchuck is well known to every dweller in the countryside of the Eastern States and Canada, where it occurs from sea-level to near the tops of the highest mountains, at altitudes of over 4,000 feet.

It is a familiar habitant of fields and grassy hillsides, especially where bordering woodland offers safe retreat. In such places it digs burrows under stone walls, rocks, ledges, old stumps, or even out in the open grass-grown fields. It commonly lives in the midst of the forest, where its dens are located in a variety of situations. The burrows are marked by little mounds of earth at the entrances and ordinarily contain from twenty to forty feet of branching galleries, one or more of which end in a rounded chamber about a foot in diameter, well lined with dry grass and leaves.

Within these warm nests the females bring forth from three to nine blind and helpless young about the last of April or early in May. A few weeks later the young appear about the entrance of the burrows sunning themselves and playing with one another, but usually ready to disappear at the first alarm. At times, however, they are surprisingly stupid and may be captured with ease. Woodchucks have practically no economic value. Their flesh, while occasionally eaten, is little esteemed, and their coarsely haired pelts are worthless as fur.

The woodchuck is a sluggish and stupid animal, which does not ordinarily go far from its burrow, but at certain seasons, especially in spring, wanders widely, as though looking over its territory before locating for the summer. It has much curiosity and often sits upright on its hind feet to look about, remaining for a long time as motionless as a statue. When one is driven into its burrow, if a person approaches quietly and whistles, it will often raise its head in the entrance and look about to satisfy its curiosity.

Its only note is a short shrill whistle, which it utters explosively at frequent intervals when much alarmed. At such times it also chatters its teeth with a rattling sound as owls sometimes clatter their beaks.

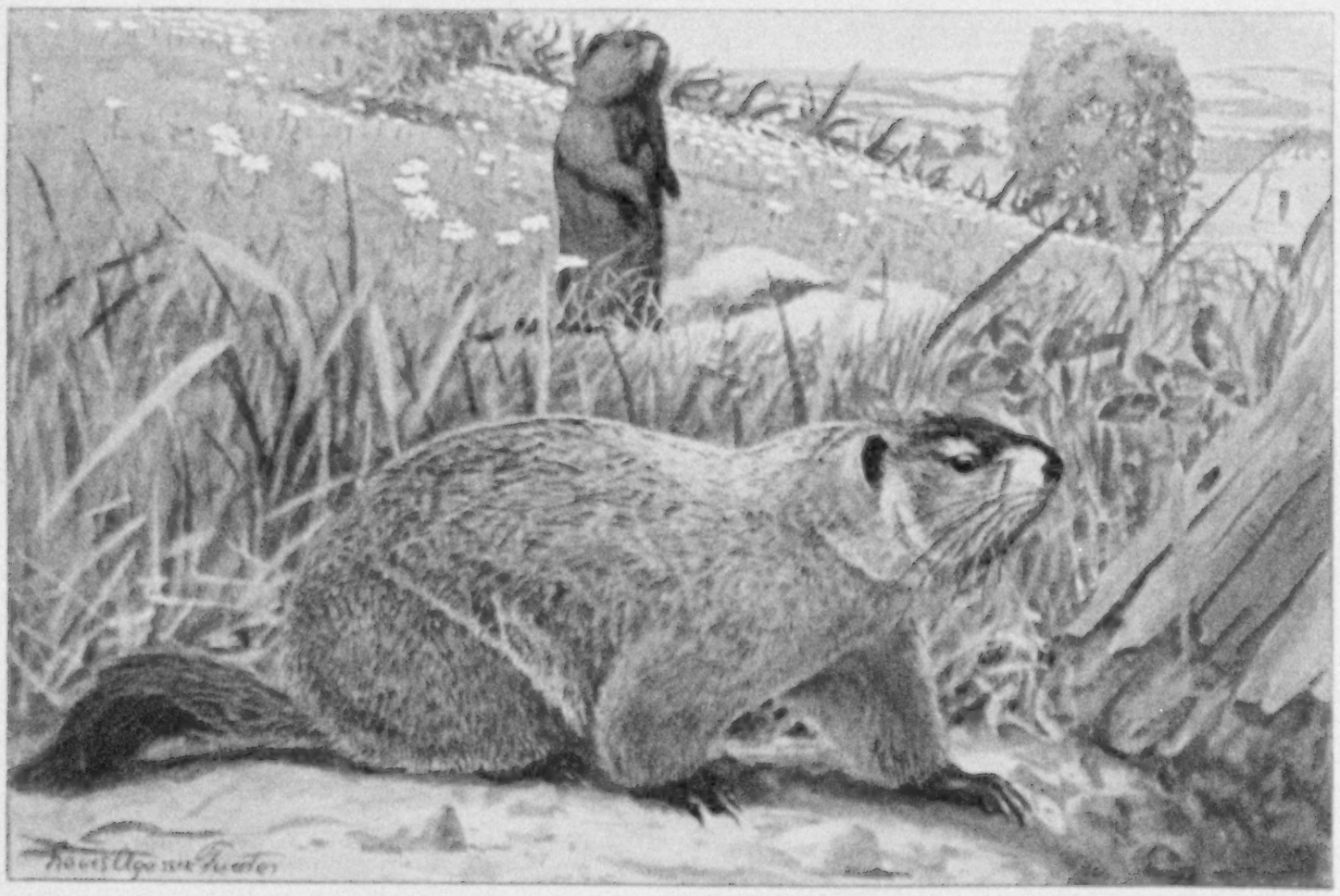
Owing to their mainly diurnal habits and persistence in living in and about the borders of fields, woodchucks are among the most widely known of our smaller mammals, and have long been the favorite game of the country boy and his dog. When cornered they will fight savagely and with their strong incisors inflict severe wounds.

They feed on grasses, clover, and other succulent plants, including various cultivated crops, especially vegetables in field and garden, where they sometimes do much damage. The holes and earth mounds they make in fields, in addition to feeding on and trampling down grasses or grain, excite a strong feeling against them, and farmers everywhere look upon them as a nuisance. In New Hampshire so great was the prejudice against them that in 1883 a law was passed placing a bounty of ten cents each on them: "*Provided*, That no bounty shall be paid for any woodchuck killed on Sunday."

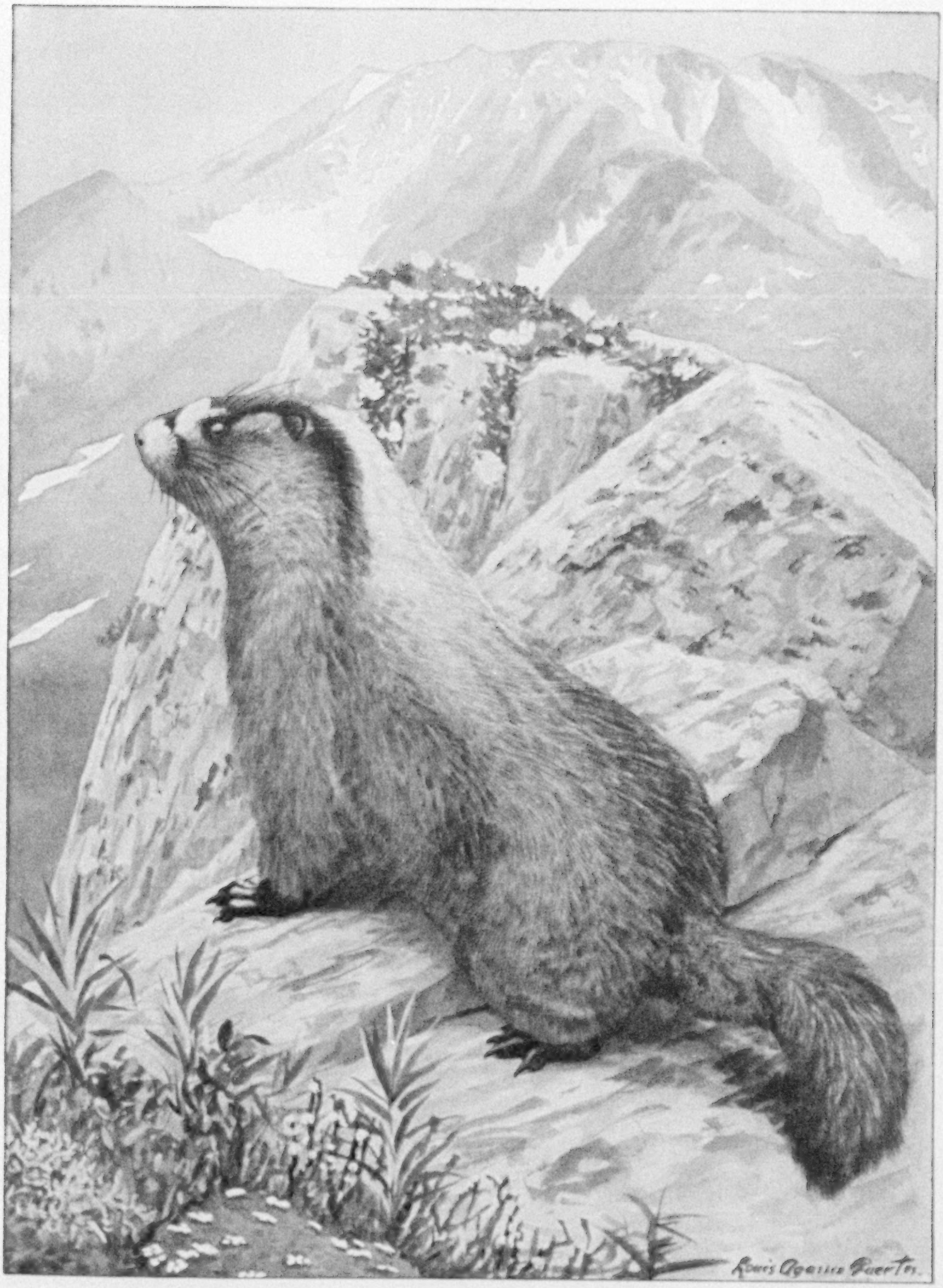
Unlike many rodents, the woodchucks do not lay up stores of food for winter. As summer draws to an end they feed heavily and become excessively fat. On the approach of cold weather they become more and more sluggish, appearing above ground with decreasing frequency until from the end of September to the first of November, according to locality, they retire to their burrows and begin the long hibernating sleep which continues until the approach of spring.

XUM

MOUNTAIN-BEAVER
Aplodontia rufa phaea



COMMON WOODCHUCK, or AMERICAN MARMOT
Marmota monax



HOARY MARMOT, or WHISTLER
Marmota caligata

Some time between February and April, according to latitude, they come forth to resume their seasonal activities. In the northern parts of their range they usually come out several weeks before the snow disappears and may be tracked in it as they wander about searching for food or a new location.

The prominence of the groundhog as a popular figure in the country lore of the Eastern States is shown by his having been given a place with the Saints on the calendar, February 2 being widely known as "Groundhog Day." It is claimed that on this date the groundhog wakes from his long winter sleep and appears at the mouth of his burrow to look about and survey the weather. If the sun shines so that he can see his shadow, bad weather is indicated and he retires to resume his sleep for another six weeks. Otherwise, the winter is broken and mild weather is predicted. Even on the outskirts of Washington some of the countrymen still appraise the character of the coming spring by the weather on "Groundhog Day."

THE HOARY MARMOT, OR WHISTLER (Marmota caligata and its relatives)

(*For illustration, see page 433*)

The whistler is the largest and handsomest of the American marmots. It is similar in proportions to the common woodchuck, but averages nearly twice its weight. Its fur, far thicker and of a better quality, might have a value in the fur trade if enough of the skins were available. As it is, the skins are used only for robes and sometimes for clothing by the Indians.

The distribution of this characteristic animal of the northern Rocky Mountains and outlying ranges extends from the Endicott Mountains, fronting the Arctic coast of Alaska, and the peninsula of Alaska, southeasterly to the Bitterroot Mountains of Idaho, Mount Rainier, the Olympics of Washington, and Vancouver Island. In the North its range extends from above timber-line down over bare slopes and through glacial valleys to the sea-level along the southern coast of Alaska. To the southward it is limited wholly to the higher elevations, usually above timber-line.

Owing to variations in climatic conditions and to isolation in different parts of its range, several geographic races of the whistler have been developed. In the mountains to the southward of its range other marmots occur as far as New Mexico and California.

When the French-Canadian voyageurs on their fur-trading expeditions first visited the Rocky Mountains they encountered the hoary marmots and applied to them the name "siffleur," or whistler, which they had already given the common woodchuck of eastern Canada. The shrill note of the hoary marmot, under favorable circumstances, may be heard more than a mile and justifies the restriction of the name whistler to it.

The whistler lives in such remote and unfrequented districts that little is known of its life history. It is diurnal in habits and loves the free open spaces of the high mountain ridges. There its loud, oft-repeated call note, striking colors, together with its habit of running about on the snowbanks, render it unusually conspicuous.

High in the mountains it usually inhabits rock slides, the tumbled rock masses of glacial moraines, or rocky points, but sometimes takes up its abode on open earth slopes or in the bottoms of little glacial valleys. Ordinarily the dens are hidden in the rock slides and broken-down ledges, or burrows are dug under the shelter of large boulders and even in open ground away from any rocky shelter.

During the sunny days of summer the whistler regularly frequents the top of some conspicuous boulder or projecting rocky point, from which it commands a sweeping view of all its surroundings. Its sight and hearing are extraordinarily keen, and when perched on its lookout it is difficult to stalk. When one has its burrow located in an open place it often sits upright on its haunches to look watchfully about, and at the first alarm disappears into its den. This watchfulness is necessary, for even in the remote alpine highlands it occupies, the whistler is beset by enemies. The most formidable of these are the great brown and grizzly bears of the North, which dig it from its burrow. In addition prowling wolves, Canada lynxes, wolverines, and eagles take occasional toll from its numbers.

Toward the end of summer, when the high alpine slopes are thickly grown with small flowering herbage, the whistler feeds heavily on many of the plants and, like the woodchuck at this season, becomes excessively fat. Before the arrival of winter it retires to the shelter of its den and begins the long hibernating sleep which may last six months or more. In spring before the snowy mantle is gone from the mountains, it is out, ready to welcome the approaching summer. A few weeks later the three or four young are born. They remain with the mother throughout the season and during their first winter may hibernate in the home den.

The unspoiled wilderness of remote northern mountain slopes and ridges where the whistler lives is also the home of the mountain sheep, caribou, and huge northern bears. As the hardy sportsmen roam these inspiring heights in search of game their attention is constantly attracted to the marmots, whose presence and shrill call notes lend a pleasing touch of life to many an otherwise harsh and forbidding scene.

THE PRAIRIE-DOG (Cynomys ludovicianus and its relatives)

(*For illustration, see page 436*)

Prairie-dogs are not "dogs," but typical rodents, first cousins to the ground squirrels, or spermophiles. As a rule, they may be distinguished from the ground squirrels by their

larger size, proportionately shorter and heavier bodies, and shorter tails. In length they vary from fourteen to over seventeen inches, and in weight from one and one-half to more than three pounds.

These rodents are limited to the interior of North America and form a small group of five species and several geographic races. Although closely alike in general form and habits, the species are divided into two sets: one, the most widely distributed and best known, having the tails tipped with black, and the other having the tails tipped with white.

On the treeless western plains and valleys from North Dakota and Montana to Texas and thence west across the Rocky Mountains to Utah and Arizona, they are one of the most numerous and characteristic animals. Southward they range into northwestern Chihuahua and one species occupies an isolated area on the Mexican table-land in southern Coahuila and northern San Luis Potosi, Mexico. Their vertical range varies from about 2,000 feet on the plains to above 10,000 feet in the mountainous parts of Colorado and Arizona.

Owing to their diurnal habits, their exceeding abundance over vast areas, and their interesting mode of living in colonies, prairie-dogs have always attracted the attention of travelers and have become one of the most widely known of our smaller mammals. All who have lived in the West, or who have merely traversed the Great Plains on the transcontinental railroads, have had their interest excited by these plump little animals sitting bolt upright by the mounds which mark the entrances to their burrows, or scampering panicstricken for shelter as the train roars through their "towns."

So strong is the gregarious instinct in prairie-dogs that they customarily make their burrows within short distances of each other, varying from a few yards to a few rods apart. The inhabitants of these communities, or "towns," as they have often been termed, vary in number from a few individuals to millions. In western Texas one continuous colony is about 250 miles long and 100 miles wide. In the entire State of Texas 90,000 square miles are occupied by prairie-dogs, and the number of these animals within this area runs into the hundreds of millions. The extent to which they occupy parts of their territory is well illustrated by one situation in a mountain valley, containing about a square mile, in eastern Arizona, which by actual count contained 7,200 of their burrows.

The burrows, from four to five inches in diameter, are usually located on flat or gently sloping ground. They descend abruptly from eight to sixteen feet, then turn at a sharp angle and extend ten to twenty-five feet in a horizontal or slightly upward course. The tunnel at the end of the steep descending shaft is always more or less irregular in course, and branches in various directions, the branches often ending in a rounded nest or storage chamber, but sometimes forming a loop back to the main passageway. Not infrequently two entrances some distance apart lead to these deep workings. A little niche is ingeniously dug on one side of the steep entrance shaft, four to six feet below the surface, to which on the approach of danger the owner retires to listen and determine whether it may or may not be necessary to seek safety in the depth of the den. It is from these vantage points that the resentful voices of the habitants come to an intruder in a prairie-dog "town" as he passes.

The black-tailed prairie-dog, which is so numerous on the Great Plains, surrounds the entrance to its burrow with a crater-shaped pyramid of soil varying from a few inches to nearly two feet in height and serving perfectly as a dike to keep out the water. The owners keep the funnel-shaped inner slopes of the rims about the entrances in good condition by setting briskly to work to reshape them at the end of a rain-storm, digging and pushing the earth in place with their feet and molding it into a more compact mass by pressing it in with their blunt noses.

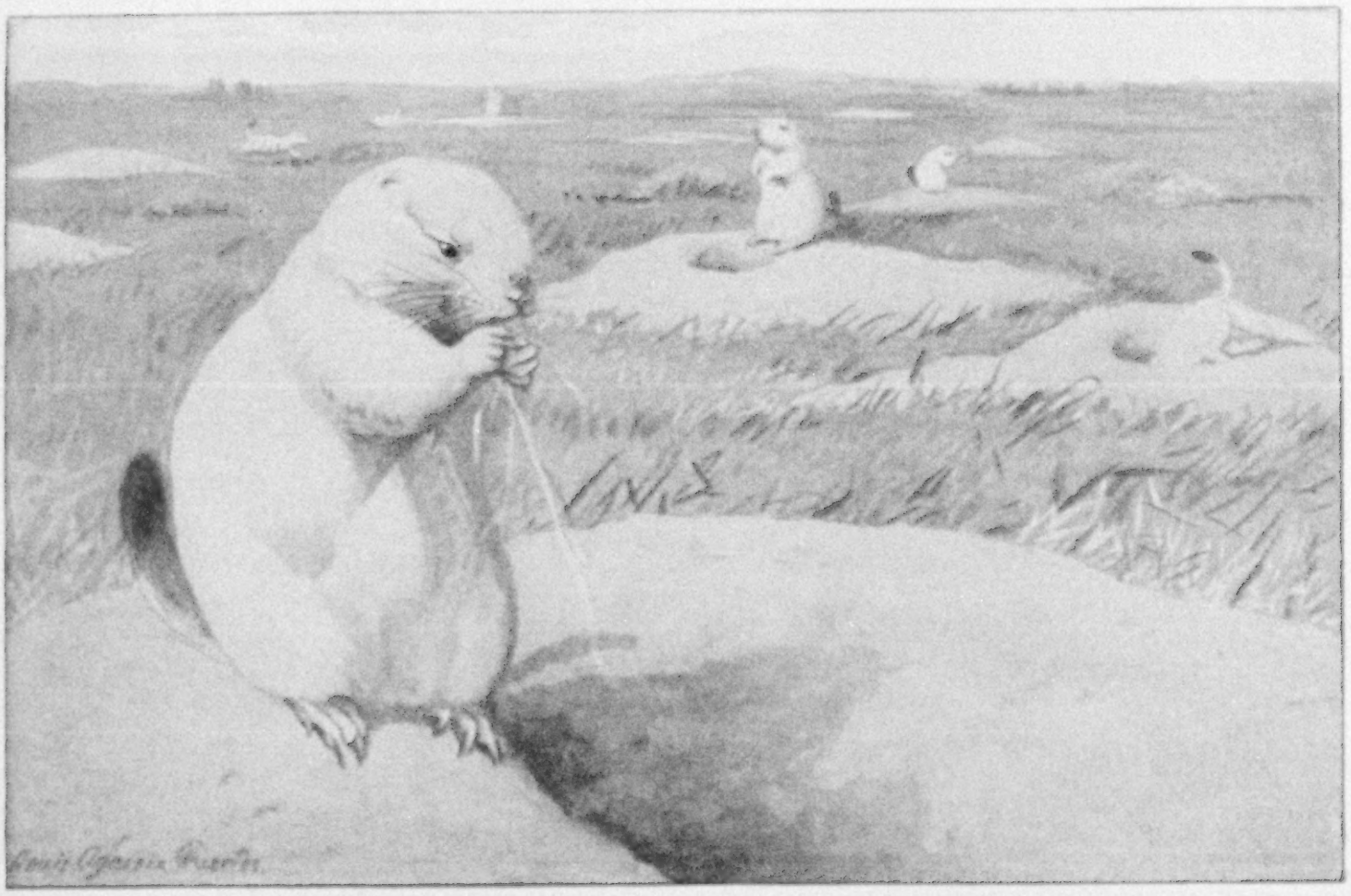
The white-tailed prairie-dogs pile the dirt from their excavations out on one side of the entrance, as in the case of most other burrowing animals. Sometimes the dirt in these piles amounts to from ten to twenty bushels, thus indicating extended underground workings.

The vivacity and hearty enjoyment of life by the occupants of a prairie-dog "town" is most entertaining to an observer. With the first peep of the sun above the horizon they are out on the mounds at the entrances of their burrows, first sitting erect on their hind feet and looking sharply about for any prowling enemy. If all is well they begin to run about from one hole to another, as though to pass the compliments of the day, and scatter through the adjacent grassy feeding ground.

The favorite food of prairie-dogs consists of the stems and roots of gramma grass and other richly nutritious forage plants. In addition they eat any native fruits, such as that of the pear-leaved cactus (*Opuntia*) and are extremely destructive to grain, alfalfa, and other cultivated crops. In addition to ordinary vegetation, they eat grasshoppers and are fond of flesh, sometimes being caught far from their homes in traps set for carnivores. They keep the grass and other vegetation cut down or entirely dug out over much of the "town" and especially in a circle about each entrance mound, apparently for the purpose of obtaining a clear view as a safeguard against the approach of any of their many four-footed enemies. This habit is exceedingly injurious to the cattle ranges and often results in much erosion of the fertile surface soil.

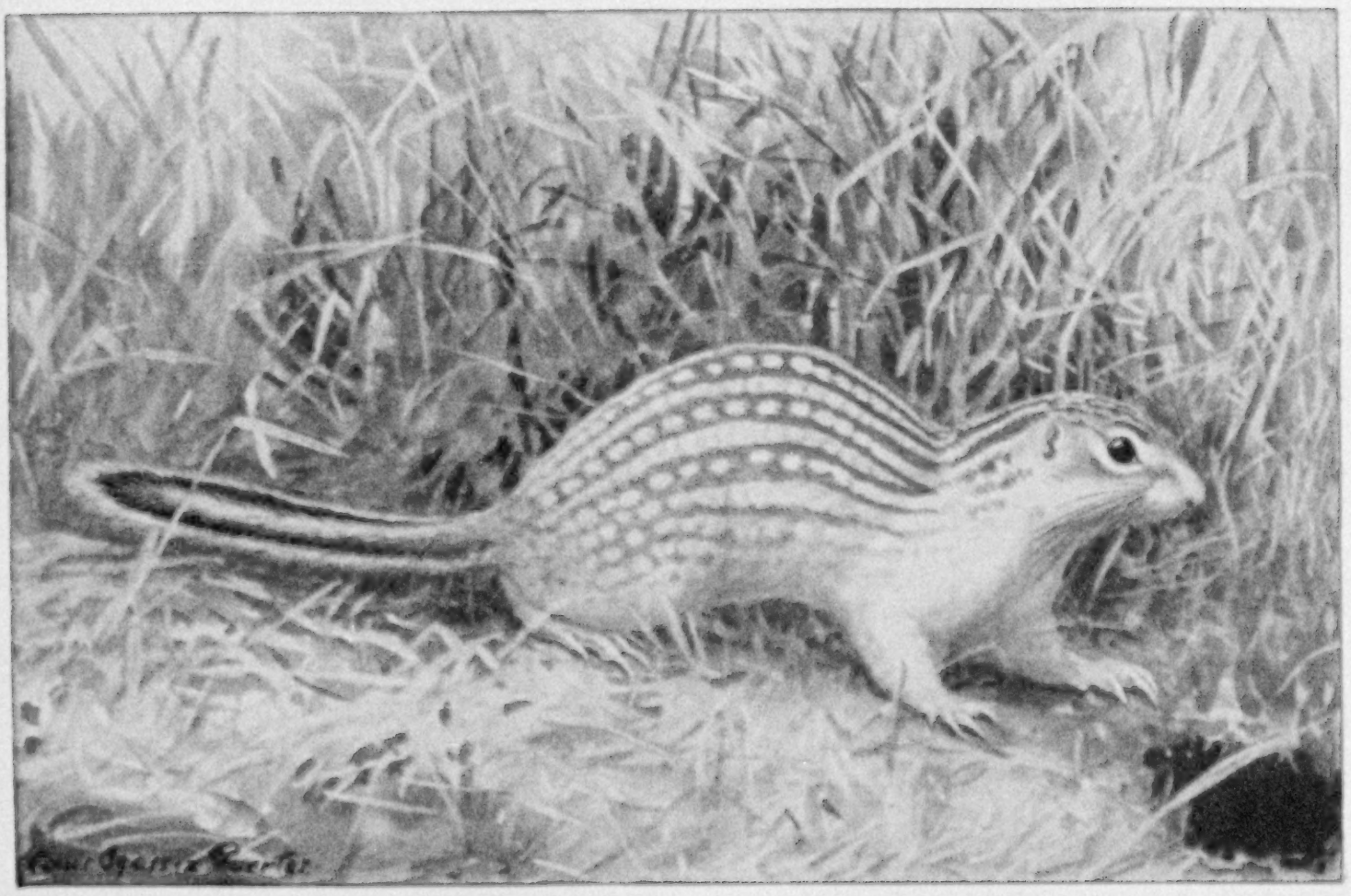
The vast numbers of prairie-dogs over so large a part of the grazing areas of the West take a heavy toll from the forage and other crops. As a consequence a campaign of destruction is being waged against them as the country becomes more and more settled, and they will eventually disappear from much of their present range. However detrimental they

XUM



PRAIRIE-DOG

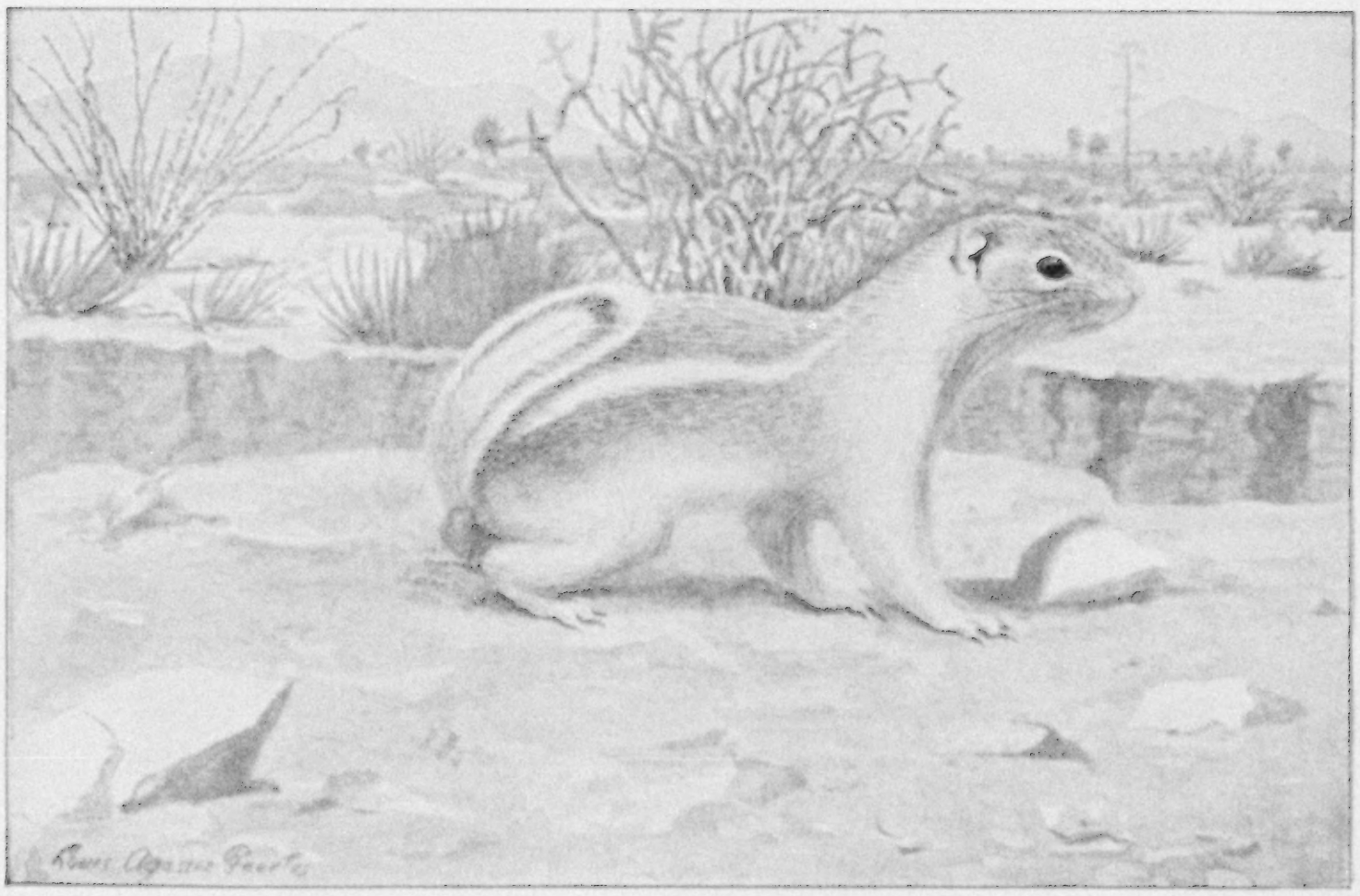
Cynomys ludovicianus



STRIPED GROUND SQUIRREL

Citellus tridecemlineatus

CALIFORNIA GROUND SQUIRREL
Citellus beecheyi



ANTELOPE CHIPMUNK
Ammospermophilus leucurus

may be from an economic point of view, they are among our most interesting species, and when taken young their playful disposition and intelligence render them most entertaining captives.

Owing to the constant danger to which they are subject from coyotes, foxes, bobcats, badgers, and black-footed ferrets, in addition to eagles and other birds of prey, prairie-dogs are constantly on the alert. At any suspicious occurrence the first to observe it runs to his entrance mound, if the danger is not pressing, but otherwise to the nearest mound, where he sits up at his full height, "barking" and vibrating his tail, ready, if necessary, to disappear instantly. At the same time the "town" is alive with scurrying figures of the habitants rushing panic-stricken for their homes, and the air is filled with a chorus of their little barking cries. When all have been frightened to cover barking continues in the burrows, but an hour or more may pass before a "dog" will reappear.

I once stalked a solitary antelope by creeping flat on the ground through a prairie-dog "town." As I drew near the first burrows, the "dogs" all rushed to their mounds, sitting there and barking at the queer and unknown animal thus invading their precincts. The strange sight excited as much curiosity among them as alarm. As I approached one mound after another the owners would become almost hysterical in their excitement and would sit first on all fours and then stand up at full height on their hind feet, the tail all the time vibrating as though worked by some mechanism, while the barking continued at the intruder as rapidly and explosively as possible. When I came within six or eight feet the "dog" would dive down his hole, sputtering barks from the depths as he went, but often would pop up again to take another look before finally disappearing. In this way I passed ten or a dozen mounds while the dozens of "dogs" off my line of progress worked themselves into a frenzy of curiosity and protest. When the stalk was finished I passed back through the "town" and my upright figure was promptly recognized by the habitants as that of an enemy and every one disappeared before I was within fifty yards of the first mound.

The common note of the black-tailed prairie-dogs is a squeaking "bark," much like that produced by squeezing a toy dog; in addition, there is a rapid chattering note, often given as the "dogs" vanish down the hole. The white-tailed species have a shriller, more chirping note. In both species the odd vibrating motion of the tail, held stiffly close to the back, is characteristic.

Prairie-dogs hibernate in severe weather, those living in high, snow-covered mountains or in the far north sometimes sleeping through five or six months. In many places their hibernation is irregular, and near the southern border of their range is limited to a few inclement days now and then. In Wyoming they come out the last of March or early in April, sometimes when there is a foot or two of snow on the ground and the temperature ranges far below zero. Under such conditions they run about over the snow during the middle of the day, feeding on projecting tips of vegetation or digging to the ground.

Beginning near the southern border of their range and proceeding north, the single litter of the season, containing from four to six young, are born in March, April, or May, and a month later, when scarcely larger than chipmunks, may be seen playing about the entrance mound. When danger appears the mother sends the young helter-skelter for the refuge of the burrow, and should any be slow about going in she rushes at them, driving them to cover with shrill barks of alarm. When about half-grown the young scatter and prepare burrows of their own. Sometimes as many as six to nine of these animals may be found in a single burrow, in which, no doubt, they have taken refuge, or it may be a reunion of the season's family.

On warm sunny days, especially at a time when nights are frosty, these fat little animals will often lie flat on the bare ground about their mounds, with legs outstretched, basking in the grateful rays. As their colonies expand by the rapid increase of their numbers, many individuals wander far in search of new locations. On the mountain plateaus of northern Arizona I know of instances where they have traversed several miles of pine and fir forest to locate in an isolated mountain park, and new colonies were established as far as six miles from their nearest neighbors.

The flesh of prairie-dogs is not unpalatable, and Navajo and Pueblo Indians are extremely fond of it. The Indians take advantage of heavy rains and turn the temporary rush of water down the holes to drown out the "dogs," and thus capture many of them.

It is inevitable that many popular misconceptions should grow up about such numerous and interesting animals as the prairie-dogs. In the West many people believe that the burrows go down to water. In reality, like many other rodents, these animals have acquired the ability by chemical action in the stomach to transform the starchy food into water. I have seen dog towns located on a few feet of soil resting on a waterless lava bed miles in extent and more than 100 feet thick, as shown by canyons cut through it, thus proving the impossibility of the prairie-dog-well legend.

Another popular belief is that the rattlesnakes and burrowing owls living in prairie-dog towns unite as a kind of happy family in the burrows of the dogs. The truth is that the owls live and breed in deserted dog holes, while the rattlesnakes visit the occupied holes to feed on the unfortunate occupants.

THE STRIPED GROUND SQUIRREL

(**Citellus tridecemlineatus** and its subspecies)

(*For illustration, see page 436*)

Small size and a series of thirteen narrow, well-defined stripes, or lines, marking the upperparts of the striped ground squirrel serve

to distinguish it from all its relatives. Its total length is about eleven inches and its form is nearly as slender as that of the weasel. Its brightly colored markings blend so well with the brown earth and plant stems in its haunts that when quiet it is difficult to distinguish. This protective coloration is of vital service to a small animal sought by all the diurnal birds of prey, as well as by coyotes, foxes, bobcats, badgers, skunks, weasels, and snakes.

The striped ground squirrel, also known as the "gopher" or "striped gopher," is restricted to middle North America, where it is distributed from southern Michigan and northern Indiana west to Utah, and from about latitude 55 degrees in northern Alberta south nearly to the Gulf coast of Texas. It ranges from near sea level in Texas up nearly to 10,000 feet in Colorado. Within these limits the varying climatic conditions have modified it into several geographic races, all having a close general resemblance.

Like most members of the squirrel family, the striped ground squirrels are diurnal in habits and well known wherever they occur. I first learned the ways of these odd little mammals as a boy on the prairies outside the city of Chicago, and later observed them in a high mountain valley in Arizona. In both regions they had the same habits. By preference they occupy grassy prairies, old fields, and similar situations. In many areas they are serious pests, owing to their abundance and their destructiveness to grain crops, but where the land is generally cultivated, the sheltering vegetation and their shallow burrows are destroyed by the plow, thus causing a decrease in their numbers.

The lives of the striped ground squirrels are so beset with peril that they always move abroad with watchful hesitation, pausing to listen, retreating toward their burrows at the slightest suspicious sound or movement, or rising bolt upright on their hind feet and remaining motionless as a small statue until satisfied that there is nothing to fear. They call to one another with a chirping note as well as with a shrill trilling whistle, and when alarmed by the presence of some enemy their warning call notes are heard on all sides as the alarm is passed, and all are on the alert to disappear down their burrows at the slightest suspicious movement.

When they have vanished their trilling notes are often heard from the depths of their burrows; but curiosity is one of their strongest traits, and if no disturbance follows one will almost immediately pop up its head to see the cause of the alarm. Boys, taking advantage of this habit, place an open slipping noose at the end of a long string around the entrance of the burrow, and, waiting developments, lie quietly a few yards to one side. The ensuing silence is too much for the ground squirrel to endure and soon its head appears above ground, the boy pulls the string, and the victim is dragged forth with the noose about its neck.

The entrance to the burrow of these ground squirrels is about two inches in diameter. It is usually located in the midst of grass or weedy growths, and has little or no fresh earth about it. The burrow descends for several inches almost vertically and then turns almost horizontally in a sinuous and erratic course, with numerous branches and side passages leading up to the surface. Most of these side entrances are kept plugged with soft earth. Opening off the main tunnel is a large nest chamber filled with fine dry grasses and other soft vegetable matter, and also one or more large storage chambers in which the owner lays up his garnered supplies of grain or other seeds for use during inclement weather.

These squirrels hibernate throughout their range, entering their long sleep in an excessively fat condition the last of September or in October. In the North they remain in a torpid state for six months or more.

Soon after they appear in spring they mate and the single litter of the year, containing from five to thirteen young, is born the last of May or early in June. The young are in an extremely undeveloped state at birth, being blind, hairless, and with the ears scarcely showing. They develop slowly and remain with the mother until toward fall, when, nearly grown, they scatter to care for themselves.

The striped ground squirrels are among the most carnivorous of rodents. Although they devote much time to gathering grain, seeds of various kinds, and even acorns and other nuts, which may be eaten on the spot or carried in their cheek pouches to their underground storage rooms, in addition they are known to eat insects and flesh whenever occasion offers. In fact, during seasons when such insect food as grasshoppers, caterpillars, and grubs is plentiful, these ground squirrels frequently feed mainly upon it. They are known to kill and devour mice and young birds, and when confined in a cage will sometimes kill and partly devour their own kind. When caught they fight fiercely, biting and struggling to escape. In captivity they show little of the gentleness and intelligence which are such pleasing characteristics of chipmunks and true squirrels.

THE CALIFORNIA GROUND SQUIRREL (Citellus beecheyi and its relatives)

(*For illustration, see page 437*)

Owing to its habits, the California ground squirrel is known locally as the digger-, rock-, or ground-squirrel. Its prominent ears, bushy tail, color, and form give it the general appearance of a heavy-bodied gray tree squirrel, but in reality it is a true spermophile and close kin to the marmots.

Spermophiles are nearly circumpolar in distribution, ranging through northern lands from central Europe across Bering Strait to the Great Lakes in North America. Many species exist in North America, varying greatly in form, size, and color. They occur mainly in

GOLDEN CHIPMUNK
Callospermophilus lateralis chrysodeirus

EASTERN CHIPMUNK
Tamias striatus

OREGON CHIPMUNK
Eutamias townsendi

PAINTED CHIPMUNK
Eutamias minimus pictus

the western part of the continent from the Arctic coast of Alaska to the southern end of the Mexican table-land. Some species are represented by enormous numbers and do great injury to cultivated crops. Among the larger and best known of the injurious species, the California ground squirrel, with its several geographic races, occupies most of the Pacific coast region from Oregon to Lower California. It has a broad vertical distribution, extending from the seashore to about 10,000 feet altitude on the western slope of the Sierra Nevada in California, and thrives under contrasting climatic conditions, as the humid northwest coast region and the most arid deserts of Lower California.

In California, where they are generally distributed and extremely numerous over great areas, these ground squirrels are most at home among the wild oats and scattered live oaks on the open slopes of the rocky foothills and thence up through the dense chaparral, scrub oaks, piñon pines, and junipers. Above this they populate many beautiful little valleys in colonies, as well as parts of the splendid open forests of pine and fir. Below they spread out from the foothills among the ranches in the great valleys. Wherever they occur they take heavy toll from the native forage plants, and in cultivated areas their devastations of crops place these spermophiles among the most serious of mammal pests.

They are omnivorous, eating insects and flesh on occasion, but feeding mainly on seeds, fruits, and many kinds of plants. The native vegetation in their haunts contains a wonderful variety of food plants, from humble weeds in the valleys to the lordly pines of the Sierra, but most attractive to these rodents are the rich food-bearers brought by the cultivators of the soil. The squirrels gather in great numbers about farms, and in feeding upon alfalfa, wheat, and other grains, grapes, peaches, apricots, almonds, prunes, pomegranates, and a variety of other crops, cause an annual loss to the farmers of California probably exceeding $20,000,000. So serious are their depredations that great sums have been spent in attempts to destroy them with poison. The Kern County Land Company, with vast holdings in the southern end of the San Joaquin Valley, in 1911 spent more than $40,000 for this purpose. This company estimated that the ground squirrels destroyed 20 per cent of the grain crop in great areas, and that twenty of them would destroy enough forage to support a cow through the year.

Ground squirrels by choice locate their burrows among slide rock, in crevices among cliffs, under boulders and roots of trees, in ditch or dry creek banks, or under stone walls, fences, or building, but in the parks of the high Sierra, as in the foothills and lowland valleys, they dig holes out in the open with conspicuous mounds at the entrances much like those of prairie-dogs.

Well-worn trails lead from one of their burrows to another and away to a distance through the wild oats in the foothills, or in the grain and forage crops of the valleys, and along these the animals travel when foraging or paying social visits. Whenever a large rock, stump, or other prominent object is convenient, they spend hours on the top sunning themselves and keeping a sharp lookout over their surroundings. From these lookout points when they suspect danger they utter a short, shrill, whistling note which may be heard at a long distance and which sends all their neighbors scurrying for shelter. They also have a lower chattering note, uttered about the burrow when resenting an intrusion or when otherwise displeased.

Ground squirrels are agile climbers on cliffs and among rocks as well as in fruit trees, live oaks, and other low trees, but I have never seen them far from the ground in large trees. When on the ground they run in a series of bounds like tree squirrels. The long, bushy tail is carried almost straight out behind when they scamper off in alarm, but at other times is curved and undulating, much as in the tree squirrels. They gather and manipulate food with their front paws, sitting upright on their haunches to eat or look about. On one occasion when I came to a foot-bridge over a broad irrigating ditch across which a number of ground squirrels were raiding an orchard, they did not hesitate to dash at full speed into the swiftly running water and swam quickly across to seek refuge in their holes on the far side.

Like other spermophiles, the California ground squirrels hibernate for months in the cold, snow-covered parts of their winter range, but remain active throughout the year in the warmer areas, where no snow falls. Throughout their range they gather stores of seeds, grain, and acorns and other nuts, carrying them in their cheek pouches to underground storerooms for use in bad weather. In the valleys of California they lie hidden in their burrows for days at a time during cold winter rains, but are out as soon as the sun reappears. One or more litters, each containing from six to twelve young, are born from March to late in summer, according to the locality. The young leave the nest and care for themselves when about half grown.

The swarming abundance of the California ground squirrel on foothill slopes and in fertile valley bottoms equals the congregations of prairie-dogs in their most populous districts. This abundance of small animal life supports a great variety of predatory species, as coyotes, foxes, bobcats, several kinds of hawks, and the golden eagle. Owing to its predilection for ground squirrels, the golden eagle is protected by law in California, where many of them build their nests in low live oaks only a few yards from the ground.

When house rats brought the bubonic plague to San Francisco a few years ago they also carried it across the bay and passed it on to the ground squirrels living in the foothills back of Oakland. Thence the disease spread among

these animals through parts of several surrounding counties. The United States Public Health Service and the local authorities in a vigorous campaign stopped the spread of this malady, but not until the potential ability of these rodents as plague-carriers had been well established. This fact and the wide distribution of the California and other ground squirrels over a large part of the continent should not be overlooked in connection with possible future outbreaks of the plague. Fortunately, investigation and field experiments on a large scale have shown that these spermophiles may be destroyed by poison over great areas at a relatively small cost.

THE ANTELOPE CHIPMUNK (Ammospermophilus leucurus and its relatives)

(*For illustration, see page 437*)

Commonly known as the antelope, or white-tailed, chipmunk, this handsome little mammal is in reality a species of spermophile, or ground squirrel. The misnomer is due, no doubt, to its small size, striped back, and sprightly ways. From the true chipmunks it may be distinguished by its heavier proportions, and from both chipmunks and all other spermophiles by its odd, upturned tail, carried closely recurved along the top of the rump. This character renders the species unmistakable at a glance and gives it an amusing air of jaunty self-confidence.

The antelope chipmunk is characteristic of the arid plains and lower mountain slopes of the Southwest from western Colorado through Utah, northern Arizona, Nevada, the southern half of California, and all of Lower California, and down the Rio Grande Valley through New Mexico to western Texas.

Within this area it occupies a wide variety of situations. It inhabits the intensely hot desert plains near sea level in Lower California, where the temperature rises to more than 125 degrees Fahrenheit in the shade and the vegetation is characterized by such picturesque forms of plant life as cactuses of many species, yuccas, fouquerias, palo verdes, ironwood, and creosote bushes; it is found also above 7,000 feet altitude on the cool plateaus and mountain slopes of Arizona and Colorado, among sage brush, greasewood, junipers, and piñon pines. It appears equally at home skipping nimbly over rocky slopes or among slide rock in arid canyons and scurrying through the brushy growth on broad sandy plains devoid of rocks.

The antelope chipmunk has the most vivacious and pleasing personality of all the numerous ground squirrels within our borders. During the many months I have camped and traveled on horseback in their haunts I have never lost interest in them. They were forever skirmishing among the bushes or dashing away down trails or over the rocks of canyon slopes, their white tails curled impudently over their backs like flags of derision at my cumbersome advance.

Their burrows are dug in a variety of places. In the open flats they enter the ground almost vertically, and often several entrances are grouped within a few yards. In some places a little mound of loose dirt is heaped up at one side of the entrance and at others there is no trace of it. Frequently, when the ground is soft, little trails lead in different directions from the entrances, and often between holes 100 yards or more apart, as though they made many social visits. The deserted burrows of other mammals are sometimes utilized to save the trouble of digging. The burrows are often under the shelter of cactuses, bushes, and great boulders or may be among crevices in the rocks.

Antelope chipmunks are extraordinarily active and continually wander far from home in search of food or in a spirit of restless inquiry. As the traveler on horseback rides slowly along he will see them racing away in front of him, sometimes climbing to the top of a bush 100 or 200 yards in advance for a better look at the wayfarer and then scuttling down and racing on again. In this way I have seen them keep ahead of me sometimes for several hundred yards instead of hiding in some hole or shelter, as they might easily do. At other times they were so unsuspicious they would permit me to pass within a few yards with slight signs of alarm. They have a chirping call, often uttered when watching from the top of a bush, and also a prolonged twittering or trilling note, diminishing toward the end.

In the higher and colder parts of their range, where snow lies long on the ground, these spermophiles hibernate for several months, but in the warmer areas they are active throughout the year. Wherever they occur they gather food and carry it to their underground storerooms in their cheek pouches. Like most ground squirrels, they eat many kinds of seeds and fruits as well as flesh and insects when occasion offers. About cultivated lands they are sometimes abundant and destructive, digging up corn or other grain as soon as it is planted and also taking toll of the ripening grain until they become a pest. In the desert they often gather about camps to pick up the grain scattered about when the horses are fed.

It is well for them that they are prolific, having one or more litters during spring and summer, with from four to twelve in each, as they have many enemies. Snakes and weasels pursue them into their burrows, while foxes, coyotes, badgers, bobcats, and many kinds of hawks, constantly reduce their numbers.

THE GOLDEN CHIPMUNK (Callospermophilus lateralis chrysodeirus and its relatives)

(*For illustration, see page 440*)

The golden chipmunk, or calico squirrel, as it is named in Oregon, is the most richly colored of the several geographic races of a widely known species, *Callospermophilus lateralis*, abundant among the open forests of yellow pines and firs of the western ranges, including

RED SQUIRREL
Sciurus hudsonicus

DOUGLAS SQUIRREL
Sciurus douglasi

GRAY SQUIRREL (and black phase)
Sciurus carolinensis

RUSTY FOX SQUIRREL
Sciurus niger rufiventer

FOX SQUIRREL
Sciurus niger

the Rocky Mountains, Cascades, and Sierra Nevada. Although commonly known as a chipmunk, this handsome animal is a ground squirrel, or spermophile, distinguished from all its kind by heavy stripes, resembling those of a chipmunk, along the sides of its back. From the chipmunks it may be distinguished at a glance by its thick-set and often almost obese proportions, which render its movements much slower and less graceful than they are with those nimble sprites. It occurs from northeastern British Columbia to New Mexico, southern California, and even in an area in the high Sierra Madre of southern Chihuahua, where an isolated representative occupies a limited range.

Their vertical distribution extends from a moderate elevation above the sea in Oregon to above 11,000 feet in southern California. They are common in the Yellowstone and other national parks, where their size, bright markings, and activities render them conspicuous.

Everywhere their habits resemble those of the various species of true chipmunks with which they associate. They live in burrows, which they dig under the shelter of logs, rocks, stumps, roots of trees, or even in open ground, as well as in the ready-made shelter of rock slides, with conies, at timberline. Their burrows at times have several entrances within a small area. Often they occupy the burrows of other animals, including pocket gophers. They excavate burrows under cabins or barns in clearings, and abandoned mining camps or old sawmill sites frequently abound with them. Nests and storage chambers are excavated off the passageways. The nests are usually made of leaves and other soft vegetable material, but in the sheep country wool, which they find in scattered tufts, is often used.

A camping party in their haunts is certain to attract them, and, as about barns, it is necessary to keep a watchful eye on them to prevent their robbing grain sacks or other supplies. When they once locate an accessible supply of grain their industry is remarkable. I have seen a dozen or more working throughout the day, making continuous hurried trips, with loaded cheek pouches, to their dens, sometimes two hundred yards away. On approach of autumn they become continually active, gathering their winter supplies.

The length of their hibernation varies with the severity of the climate, but is rarely under five months. It is said to run through seven months on the higher mountains of southern California. They usually go into winter quarters in September or early in October, but occasionally one may be seen out as late as December. At this time they have become so fat that their movements are very sluggish. One kept as a pet for eleven years at Klamath Falls, Oregon, is reported to have hibernated regularly each winter. In Montana they retire to their dens in September and come out in March. They mate soon after they appear in spring and the young, four to seven in number, are half grown the last of May.

Like true chipmunks, these spermophiles are fond of weedy clearings or other openings in the forest, where stumps, logs, rocks, and old fences offer plentiful shelter and many elevated vantage points where they may sit by the hour watching the doings of their small world. They have a sharp whistling or chirping call note, usually uttered as a warning cry, but sometimes as a social call. They do not like gloomy or stormy weather and generally lie hidden at such times, but on sunny days are so actively engaged in foraging, running along the tops of logs, or perching on the tops of stumps and large rocks that they add greatly to the pleasant animation of the forests where they live. When running they usually carry the tail elevated like a chipmunk.

They sun themselves for hours on elevated points, sometimes lying quiescent and again sitting bolt upright, but always watchful and ready to disappear at the slightest alarm. This watchfulness is necessary, for their enemies are abroad at all hours. They are the prey of bobcats, foxes, coyotes, weasels, snakes, and hawks.

The golden chipmunk and its related subspecies are omnivorous feeders. They show a strong predilection for bacon when looting camp stores and eat any kind of meat with avidity. Young birds and birds' eggs are devoured whenever found, as are also grasshoppers, beetles, flies, larvæ, and many other insects. The number of kinds of seeds eaten is almost endless and includes chinquapin and pine nuts, rhus, alfileria, violet, lupine, ceanothus, and others. They also eat roses and other flowers, green leaves, wild currants, gooseberries and other fruit, and small tuberous roots. They often climb bushes and low trees, at least 30 feet from the ground, after nuts and berries. The capacity of their cheek pouches is shown by one instance, when one animal was loaded with 750 serviceberry seeds. The pouches of another contained 360 grains of barley, another 357 of oats. Bold and persistent camp robbers, their depredations cover all articles of food, including bread and cake, and they sometimes do considerable injury to small mountain grain fields.

I had the pleasure of living in the mountains of New Mexico and Arizona for several years where these attractive ground squirrels were numerous, and vividly remember them as among the most interesting of the woodland folk. Their friendliness about forest cabins is notable and with a little encouragement they become extremely confiding and amusing visitors.

The young are playful, pursuing one another in apparent games of "tag" over rocks, stumps, and logs. When partly grown they have all the heedlessness of youth and on one occasion an observer saw the mother repeatedly push the young back into crevices in a rock slide with her front feet, as they persisted in trying to come out to look at the strange intruder in their haunts.

XUM

THE EASTERN CHIPMUNK (Tamias striatus and its relatives)

(For illustration, see page 440)

The chipmunks are close relatives of the tree squirrels, but live mainly on the ground, are provided with cheek pouches for carrying food to their hidden stores, and have many ways similar to those of the spermophiles, or ground squirrels. They are nearly circumpolar in distribution, ranging through eastern Europe and northern Asia as well as from the Atlantic to the Pacific in North America. On this continent they are far more numerous in species and individuals than in the Old World, and their center of abundance appears to lie in the mountainous western half of the United States. Their extreme range extends from near the Arctic Circle in Canada to Durango and Middle Lower California, Mexico.

As a group the chipmunks are widely known for their grace, beauty of coloration, and sprightly ways. Among the handsomest and most familiar is the common chipmunk of Canada and the United States east of the Great Plains. Within this area it is divided into several geographic races, of which the best known is the brightly colored animal occupying all the wooded region from the Great Lakes to Nova Scotia and New England, which is the subject of the accompanying illustration. Its vertical distribution extends from sea level to the summit of Mount Washington, where it may be seen on pleasant summer days.

The eastern chipmunks, like most of their kind, belong to the forest and its immediate environment. Favorite haunts are rocky ledges covered with vines and brush, half-cleared land, the brushy borders of old pasture fences, stone walls, and similar situations. In early days they were so plentiful in places that they made serious inroads on the scanty crops of the settlers, and bounties were offered for their destruction.

No one who visits the woods of the eastern States or Canada can fail to observe with pleasure the alert, attractive ways of these little squirrel-like animals. They are everywhere, including the vicinity of summer camps in the forest, and, if encouraged, prove most attractive and friendly neighbors. To such small beasts the world is peopled with enemies against which the only safeguard is eternal watchfulness. This accounts for the hesitating advances and retreats so characteristic of these chipmunks, which at the first sudden movement of any suspicious object, or loud noise, disappear like a flash. They soon learn to recognize a friend and in many places come regularly into camp buildings to receive food. I doubt, however, if they ever become quite so friendly as some squirrels under similar conditions.

Like most of the squirrel tribe, they are endowed with much curiosity, and at the appearance of anything unusual, but not too alarming, they seek some safe vantage point from which to peer at it with every sign of interest. They are extremely timid and wary, however, and if doubtful move by little cautious runs, stopping to sit up and look about, often mounting a stump, log, or a side of a tree trunk for the purpose, the tail all the time moving with slow undulations. If alarmed they dash away to the nearest shelter, the tail held nearly or quite erect and sometimes quivering excitedly. When running to shelter they often utter chattering cries of alarm. Their principal enemies are cats, weasels, martens, foxes, snakes, birds of prey, and the untamed small boy with his dog. Weasels, the supreme terror of their existence, follow them to the depths of their burrows and kill them ruthlessly.

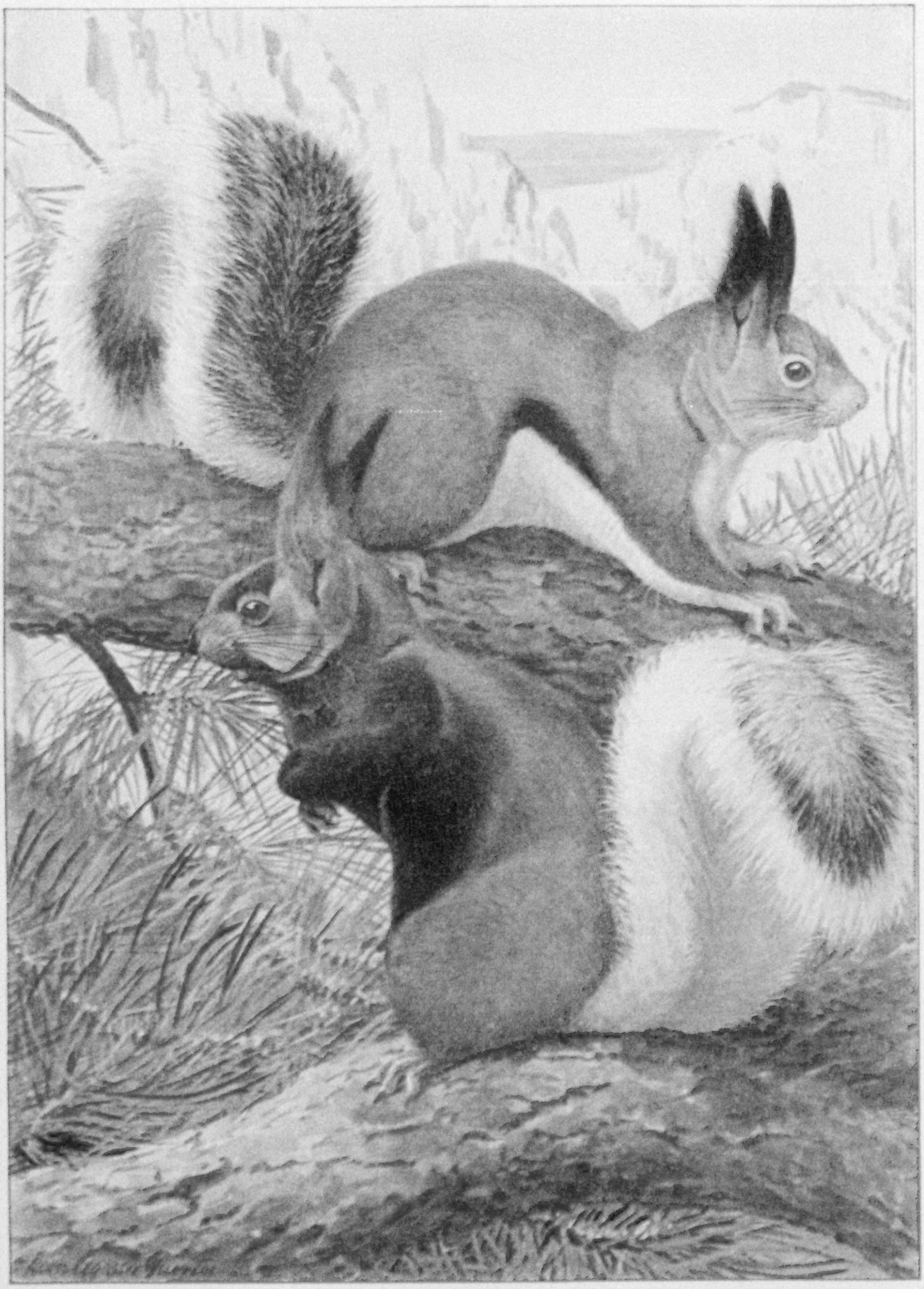
These chipmunks are sociable and playful, often pursuing one another, first one and then the other being the pursuer, as though in a game. They race along fence tops and old logs and up stumps and even the lower parts of tree trunks. Lovers of bright, sunny weather, they usually remain hidden in their burrows during stormy days. If they venture out at such times they are quiet and show none of the mercurial liveliness which characterizes them when the weather is pleasant.

Their food includes a great variety of cultivated and wild plants, as wheat, buckwheat, corn, grass seed, ragweed seed, hazelnuts, acorns, beechnuts, strawberries, blueberries, wintergreen berries, mushrooms, and many others. In addition they eat May beetles and other insects and insect larvæ, snails, occasional frogs, salamanders, small snakes, and many young birds and eggs.

At all seasons they fill their cheek pouches with food to be carried away to their dens, but toward the end of summer or early fall they work industriously laying up stores of seeds and nuts. Sometimes these stores, hidden in chambers excavated for the purpose or in hollow logs and similar places, contain several quarts of beechnuts or other nuts or seeds. Small quantites of such food are hidden here and there under the leaves or in shallow pits in the ground. Store-rooms in one burrow contained a peck of chestnuts, cherry pits, and dogwood berries, and another had a half bushel of hickory nuts.

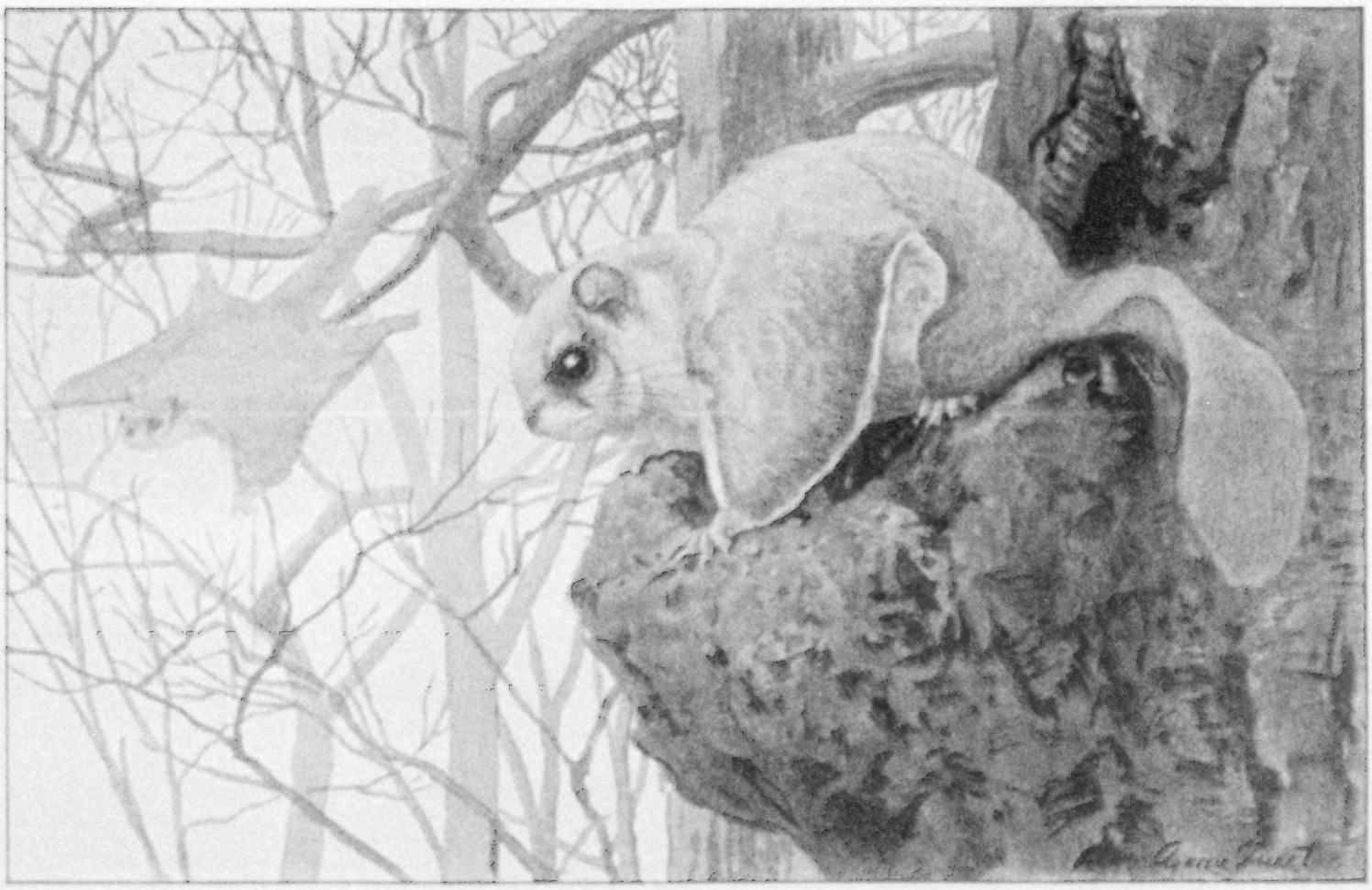
While at a summer camp I once saw one of these chipmunks give an exhibition of the exquisitely keen power of scent which must be necessary to recover scattered stores. The chipmunk had been coming repeatedly down a wooded slope in full view for twenty-five yards or more to the floor of the porch for food supplied by the campers. While it was absent carrying food to its burrow I placed a few nut meats on the flat top of a stump about fifteen feet to one side of the porch and farther away than the point where the chipmunk was being fed bread crumbs. On its return several minutes later, instead of going as usual to the porch, it ran directly to the stump, climbed up it, and promptly made off with the nuts, which it had evidently located from afar. They sometimes climb beeches and other trees to gather nuts even to a height of fifty or sixty

XUM

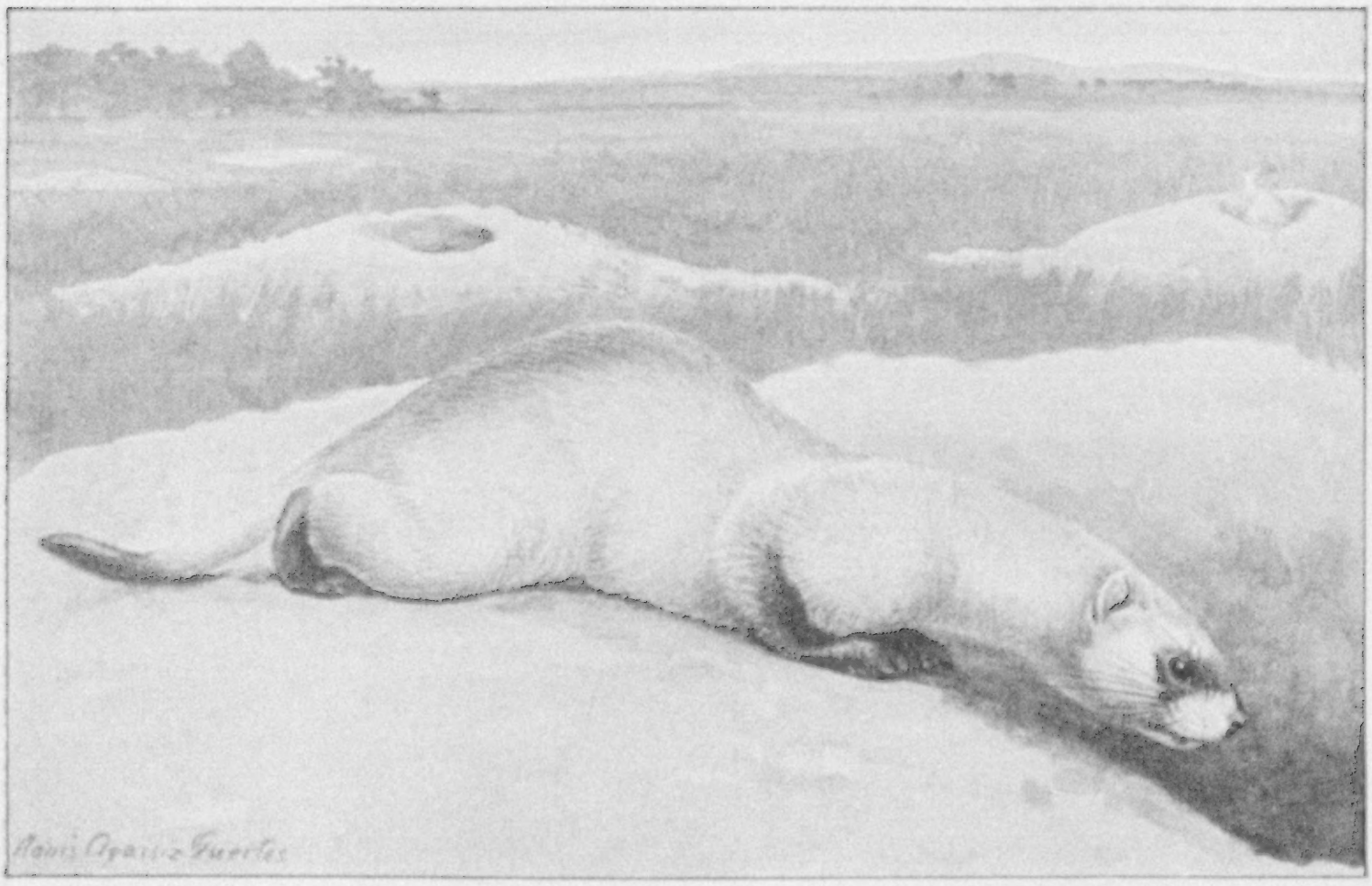


ABERT SQUIRREL
Sciurus aberti

KAIBAB SQUIRREL
Sciurus kaibabensis



FLYING SQUIRREL
Glaucomys volans



BLACK-FOOTED FERRET
Mustela nigripes

feet, and are commonly seen on low limbs and in bushes.

The entrances to the burrows are usually under logs, roots, or rocks, or the den may be in a hollow log, stump or base of a tree, or even under a cabin in the woods. The burrows in the ground are commonly a series of tunnels some yards in length, with an oval nest and storage chamber two or three feet underground, and with branches from the main passageway. The nest chamber, a foot or more in diameter, is filled with fragments of dry leaves and other soft vegetable material. One chamber is usually used for sanitary purposes. The used entrance hole is commonly without a sign of dug earth about it, the loose soil from the burrow and its chambers apparently having been thrown out at another opening, which appears to be used for this purpose only and is kept plugged with earth.

Throughout most of the northern half of its range these chipmunks usually hibernate from some time in October until March. Their hibernation is far less profound than that of the woodchuck and they not infrequently appear above ground during periods of mild weather, even in midwinter. The hibernating period is shorter in the southern part of the range.

They vary much in numbers from year to year and at times appear to increase suddenly in localities where food is plentiful, indicating a probable food migration. The young, numbering from four to six in a litter, are born at varying times between the last of April and late summer, indicating the possibility of more than one litter a season.

The most characteristic note of this chipmunk is a throaty *chuck, chuck,* which is ordinarily used as a call note, but which in spring is uttered many times in rapid succession to express the seasonal feeling of joy and well being, thus taking on the character of a song. Such joyful notes may be heard on every hand in places where the little songsters are numerous. In addition, they have a high-pitched, chirping note and a small churring whistle when much alarmed.

THE OREGON CHIPMUNK (Eutamias townsendi and its relatives)

(*For illustration, see page 441*)

The resident species of birds and mammals in the humid coastal region of Oregon, Washington, and southern British Columbia are strikingly characterized by their darker and browner colors in comparison with closely related species in more arid districts.

The Oregon chipmunk is one of the common species showing marked response to these local climatic conditions and is the darkest of all the many species of chipmunks in the Western States. This chipmunk is one of several geographic races into which the species is divided by changing environment. The species, as a whole, ranges along the west coast from British Columbia to Lower California, and the races at the extremes of the line differ much in color.

As befits a habitant of the humid forested region, the Oregon chipmunk is robustly built and distinctly larger than the other chipmunks of the Western States. It is common and generally distributed throughout this region, occurring from among the drift logs along the ocean beach to above timberline on the Cascade Mountains. Within these limits it frequents almost every variety of situation. It occurs in the midst of gloomy forests of giant spruces, cedars, and firs, but is particularly fond of old fences and brush patches on the borders of farm clearings in the valleys as well as the vicinity of rocky ledges, brush piles, and fallen timber, where the low thickets offer a variety of food-bearing plants and ready shelter.

On the mountains it is most numerous about rock slides and "burns" or other openings in the forest. Several pairs usually haunt the vicinity of old sawmills and of mountain cabins. Like others of their kind, they are alert and vivacious, varying in mood from day to day, but always interesting. At times they are excessively shy and retiring, and a person might spend a day in their haunts without seeing or hearing one, although it is safe to say that the intruder had been seen and every foot of his progress noted by the chipmunks. On another day, perhaps because the sun shines more brightly and nature is in a happier mood, the animals appear on all sides. Their slowly repeated sociable *chuck, chuck,* is heard from the depths of the brushy covert as well as from the tops of stumps, logs, rocks, or other lookout points where they sit to view their surroundings. If alarmed they utter a sharp, birdlike chirping note as they vanish in the nearest shelter. As one moves about in their haunts he may now and then see one appear for a moment above the undergrowth in a tall bush, on top of a stump, and sometimes even mounting a few yards up a tree trunk to observe the cause of the disturbance, only to vanish quickly.

They are always skirmishing for food, and carrying it in their cheek pouches to hidden stores. On the approach of winter this activity becomes very marked. A surprising variety of fruits and seeds are eaten and stored, among them the salmonberry, red elderberry, black-capped raspberry, thimble berry, blackberry, blueberry, gooseberry, thistle seed, dogwood seed, hazelnuts, acorns, and others. They have favorite feeding places, such as the top of a stone or stump or the shelter of a log where they carry nuts or other seeds. These places are always marked by little piles of empty shells or chaff from seeds. About ranches they raid grain fields and other crops, sometimes in numbers sufficient to do considerable damage.

In sheltered spots they make underground burrows with nest chamber and store-rooms excavated along the passages. They usually retire to these dens to hibernate during the last of September or first of October, and appear again about March or April, often long before the snow disappears. During fall and early

winter they are sometimes seen running about over newly fallen snow. One which was dug from its winter quarters in British Columbia the last of November would move about slowly and sleepily if teased, but when left undisturbed would curl up and go to sleep again. This indicates the difference between the light and often broken hibernation of chipmunks and the deep lethargy which possesses ground squirrels in the North at this time. Toward the southern end of their ranges neither chipmunk nor ground squirrel hibernates. They mate soon after they awake from their winter sleep, and the young, two to five or six in number, are born from April to June. Whether more than one litter is born during a season, is, like many other details concerning the lives of these attractive animals, still to be learned.

THE PAINTED CHIPMUNK (Eutamias minimus pictus and its relatives)

(*For illustration, see page 441*)

The preceding sketch tells how the Oregon chipmunk, living under a cool, humid climate, in a region of great forests, has responded to its environment by developing dark colors and a robust physique. The painted chipmunk of the Great Basin has given an equally perfect response to entirely different conditions. It is one of the geographic races of a species peculiar to the sagebrush-covered plains and hills from the Dakotas across the Rocky Mountains and the Great Basin region to the east slope of the Cascades and the Sierra Nevada. Its home is on treeless plains, in a climate characterized by brilliant sunshine and clear, dry air. In this environment the painted chipmunk has developed a smaller and slenderer body than the Oregon species, and strikingly paler colors.

These differences in physique are accompanied by equal differences in mental and physical expression. These little animals are exceedingly alert and agile, darting through dense growths of bushes with all the easy grace of weasels. When running they hold the tail stiffly erect. When alarmed they utter a shrill chippering cry, especially when darting into shelter. They also have a chucking call, uttered at intervals, which may be used merely as a note of sociability or to put their neighbors on the alert.

Although one of the most distinctive animals of the sagebrush plains, this chipmunk also ranges into the borders of open forests on the mountain sides. It is most numerous on flats and foothill slopes among heavy growths of sage and rabbit brush. When its territory is invaded by settlers it does not hesitate to gather about the borders of fields and even to raid barns in search of grain and other food. Its burrows are dug under large sagebrush and other bushes and under rocks and similar shelter.

As with others of their kind, painted chipmunks habitually gather seeds of many plants and carry them in their cheek pouches to their underground dens. In addition to seeds and green vegetation, they eat any fruits growing in their haunts, and also many insects, especially grasshoppers and larvæ. In one locality in Nevada during June and July more than half their food consisted of a web worm and its chrysalids with which the sage bushes swarmed. The chipmunks climbed into the bushes and pulled the larvæ from the webs. As half the bushes were infested, the work of the many chipmunks had a material effect in reducing the numbers of this pest. The vegetable food eaten includes the seeds of *Ribes*, *Kuntzia*, *Sarcobatus*, pigweed, and many other weeds, serviceberry, various grasses, oats, wheat, and the seeds of small cactuses. They regularly climb into the tops of large sage and other bushes for their seeds and the ground beneath is often covered with the small sections of twigs cut by them. They climb readily and often travel from bush to bush through tall thickets like squirrels in tree-tops. On warm mornings after frosty nights they may be seen in the tops of the bushes basking in the sun.

Throughout most of their range they begin hibernation in September or October, and reappear early in spring. The young appear a month or more later, and litters containing from two to six may be born throughout the summer, indicating the possibility that several litters may be born to the same pair in a season.

So alert and shy are they that even a person in their haunts day after day will see but few of them. Their hearing is extremely acute, and even at a great distance the footsteps of an intruder sets them all on the alert. On every side they run swiftly to cover before the observer has opportunity to see them. In such places a large setting of baited traps will reveal their presence in surprising numbers. In one locality, during a brief visit, traps set among the brush for other small mammals yielded more than forty chipmunks.

On stormy and cloudy days, especially if the weather is cool, painted chipmunks remain in their dens, but on mild sunny days they frisk about with amazingly quick darting movements. A horseman riding along a road leading through a sagebrush flat will frequently see them racing across the road often several hundred yards away, the sound of the horse's footfalls having alarmed the chipmunks over a wide area. Here and there one may be seen climbing hastily to the top of a tall bush to take a look at the cause of alarm before finally seeking concealment. When pursued among the bushes they often run considerable distances before taking refuge in a burrow. When hard pressed they will enter the first opening encountered, but if it is not its own home the fugitive soon comes out and scampers away, apparently fearful of the return of the owner or perhaps owing to his presence.

Apparently, as in the case of many other desert mammals, the painted chipmunk, with its related races, is able to subsist without drink

XUM

Winter Summer

LEAST WEASEL

Mustela rixosa

LARGE WEASEL, or STOAT (Winter and Summer)

Mustela arcticus

MARTEN, or AMERICAN SABLE
Martes americana

AMERICAN MINK
Mustela vison

ing, since it is often seen far out on arid plains many miles from the nearest water.

As with all its kind, the world of the painted chipmunk is filled with imminent peril of sudden death. Overhead, gliding on silent pinions, are hawks of several species, while on the ground snakes, weasels, badgers, bobcats, foxes, and coyotes are ever searching for them as prey.

THE RED SQUIRREL (Sciurus hudsonicus and its relatives)

(*For illustration, see page 444*)

Every one who has visited the forests of Canada and northeastern United States knows the vivacious, rollicking, and frequently impudent red squirrel. This entertaining little beast, known also as the pine squirrel and chickaree, has little of that woodland shyness so characteristic of most forest animals. It often searches out the human visitor to its haunts and from a low branch or tree trunk sputters, barks, and scolds the intruder, working itself into a frenzy of excitement. This habit, combined with the rusty red color and small size of the animal, about half that of the gray squirrel, renders its identity unmistakable. It has distinct winter and summer coats, but in both the rusty red prevails. The winter dress is distinguished, however, by small tufts on the ears.

The red squirrel, with its related small species, occupying most of the wooded parts of North America north of Mexico, forms a strongly characterized group, with no near kin among the squirrels of the Old World. In its geographic races it ranges through the forests of all Alaska and Canada and south to Idaho, Wyoming, the Dakotas, Wisconsin, northern Indiana, all the Northeastern States to the District of Columbia, and along the Alleghenies to South Carolina. Owing to its small size, this animal, like the chipmunk, is considered too small for game, although occasionally hunted for sport. As a consequence its increase or decrease is usually governed by the available food supply, although man interferes locally when it becomes too destructive.

This squirrel shows a strong preference for coniferous forests, whether of hemlock, spruce, fir, or pine, but may be common in woods where conifers are few and widely scattered. Although usually diurnal and busily occupied from sunrise until sunset, it sometimes continues its activities during moonlight nights, especially when nuts are ripe and it is time to gather winter stores. During warm, pleasant days in spring and fall, when the nights are cool, it often lies at full length along the tops of large branches during the middle of the day, basking in the grateful warmth of the sun.

The nests, which are located in a variety of situations, are made of twigs, leaves, or moss, and lined with fibrous bark and other soft material. Some are in knot-holes or other hollows in trees, others may be built outside on limbs near the trunk, and still others are in burrows made in the ground under roots, stumps, logs, brush heaps, or other cover offering secure refuge. Apparently several litters of young, containing from four to six, are born each season, as they have been found from April to September.

They do not hibernate, but are active throughout the year, except during some of the coldest and most inclement weather. To provide against the season of scarcity, they accumulate at the base of a tree, under the shelter of a log, or other cover, great stores of pine, spruce, or other cones, sometimes in heaps containing from six to ten bushels. They also hide scattered cones here and there and place stores of beechnuts, corn, and other seeds in hollows or underground store-rooms. They are fond of edible mushrooms and sometimes lay up half a bushel of them among the branches of trees or bushes to dry for winter use. In the western mountains their great stores of pine cones are often robbed by seed-gatherers for forestry nurseries. In winter they tunnel through the snow to their hidden stores and sometimes continue the tunnels from one store to another.

Each squirrel makes its home for a long period in or about a certain tree. There he carries his cones to extract the seeds, and on the ground beneath it the accumulation of fallen scales and centers of cones sometimes amounts to fifteen or twenty bushels. In addition to the seeds of the various conifers, red squirrels eat many kinds of fruits and seeds; they also raid cornfields and orchards and even make nests in barns and woodsheds to be near the food supply which some farmer's industry has collected.

Red squirrels have the interesting habit of voluntarily swimming streams and lakes, including such bodies of water as Lake George and even the broadest parts of Lake Champlain. When they thus cross the water and make their migrations, there is little doubt that they are usually in search of a better feeding ground.

The red squirrels and related species have the greatest variety of notes possessed by any of the American members of the squirrel family. In addition to the barking, scolding, chattering notes already mentioned, they have a real song, which is one of the most attractive of woodland notes. It is a long-drawn series of musical rolling or churring notes, varied at times by cadences and having a ventriloquial quality rendering it difficult to locate. These notes never fail to awaken pleasurable emotions and to recall to me my early boyhood in the Adirondacks, where the spring songs of the chickarees were among the first calls which awakened me to the marvelous beauties of nature.

The worst trait of the red squirrel and one which largely overbalances all his many attractive qualities is his thoroughly proved habit of eating the eggs and young of small birds. During the breeding season he spends a large part of his time in predatory nest hunting, and the number of useful and beautiful birds he

thus destroys must be almost incalculable. The number of red squirrels is very great over a continental area, and one close observer believes each squirrel destroys 200 birds a season. Practically all species of northern warblers, vireos, thrushes, chickadees, nuthatches, and others are numbered among their victims. The notable scarcity of birds in northern forests may be largely due to these handsome but vicious marauders.

In the fur country these squirrels are much disliked by the trappers for their constant interference with meat-baited traps. Many fall victims to their carnivorous desires, but their places are soon taken by others.

The energy and unfailing variety in the performances of red squirrels always keep the attention of their human neighbors. Among other interesting activities, their pursuit of one another up and down and around the trunks of trees, over the ground, along logs, back and forth in the most reckless abandon, is most entertaining to watch. These pursuits among the young are playful and harmless, but among the males in spring are of the most deadly character. I have seen the victim go up and down tree after tree, shrieking in fear and agony and leaving a trail of blood on the snow as he tried to escape his truculent pursuer.

Such scenes as this, combined with our knowledge of its bird-killing habits, appear belied by the exquisite grace and beauty of this squirrel as it sits on a branch and sends its musical cadences trilling through the primeval forest. So confirmed are red squirrels in the destruction of bird life, however, they should not be permitted to become very numerous anywhere and it may eventually become necessary to outlaw them wherever found.

THE DOUGLAS SQUIRREL (Sciurus douglasi and its relatives)

(*For illustration, see page 444*)

In all details of size, form, notes, and habits the Douglas squirrel gives testimony to its descent from the same ancestral stock as the common red squirrel (*Sciurus hudsonicus*). The typical Douglas squirrel, represented in the accompanying illustration, is one of several geographic races of a species which ranges from the Cascades and Sierra Nevada to the Pacific, and from British Columbia south to the San Pedro Martir Mountains of Lower California. The home of the Douglas squirrel is amid the wonderful coniferous forests of western Oregon, Washington, and southern British Columbia. As in other mammals of this extremely humid region, the colors of its upperparts are dark brown, in strong contrast to the much paler and grayer colors of the closely related subspecies living in the clearer and more arid climate of the Sierra Nevada in California. These squirrels are known locally by a variety of common names, including pine squirrel, redwood squirrel, and "drummer."

Although usually not quite so noisy and self-assertive as the irrepressible little red blusterer of eastern forests, the Douglas squirrel is also notable for its rollicking, chattering character and sometimes cannot be outdone in its amusing displays of aggressive impudence. When the animals are numerous the air at times resounds with their call notes or songs, one answering the other, now near and now far, until the somber depths of the mighty forest seems peopled with a multitude of these joyous furry sprites. Their song, resembling that of the red squirrel, is a rapid trilling or bubbling series of notes, long drawn out and sometimes varied by cadences. It is so musical that it seems more like the song of some strange bird than of a mammal. When these squirrels are not common they are much less given to song and seem subdued and shy, as though impressed by the vast loneliness of their deep forest haunts.

At mating time, early in spring, they are especially noisy, and again in summer when the first litter of young are out trying their youthful pipes in expression of their cheerful well being. They frequently come down on a low branch or on the trunk of a tree and chatter, bark, and scold at man, dog, or other intruder, now rushing up and down, or making little dashes around the tree trunk, their necks outstretched and tails flirting with a great show of anger and contempt highly entertaining to see. They are restlessly active at all seasons of the year and habitually chase one another through the forest with an appearance of rollicking fun which may many times be in more deadly earnest than appears to the casual observer.

In winter their tracks in the snow lead from tree to tree, along the tops of logs and fences, and in all directions to hidden stores of food, which they appear to be able to locate with unerring certainty under the snow. An adventurous spirit leads them to race away from the forest, along fence-tops, to pay visits to ranch buildings and even to villages and small towns. Like their eastern relative, the Douglas squirrels are omnivorous, feeding on the seeds of all the conifers in their range, including spruces, firs, pines, and redwoods, and also upon acorns, and a great variety of other seeds, fruits, and mushrooms, insects, birds' eggs, young birds, and any other meat they can find. Owing to their habit of interfering with meat-baited traps, they are a nuisance to trappers. They frequently visit orchards and carry off apples and pears, from which they extract the seeds. They have been seen also to visit the wounds made on a willow trunk by sapsuckers to drink the flowing sap. Their feet and the fur about their mouths are often much gummed with pitch from working on pine cones.

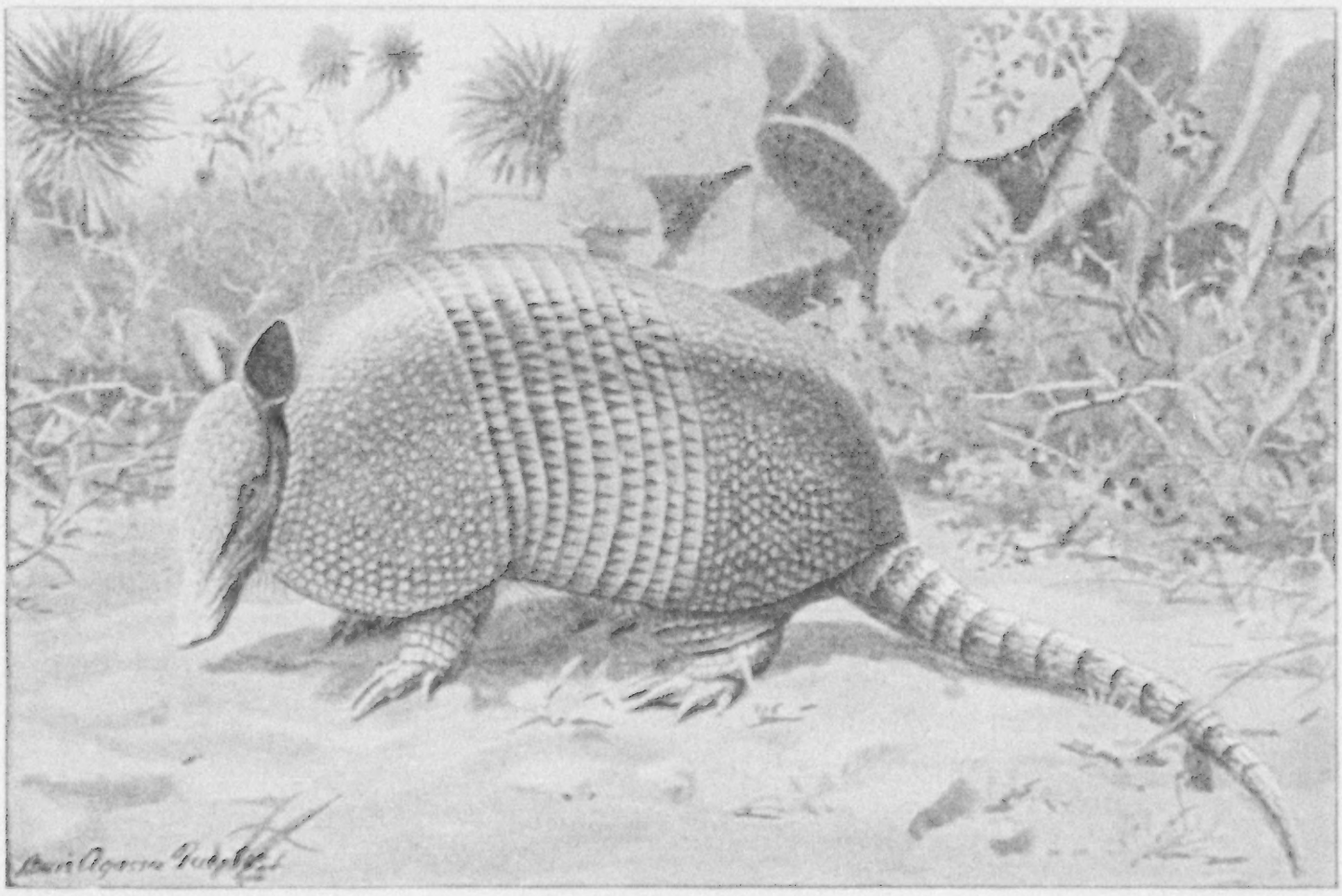
In many places the soft, moist earth in the woods is riddled with little pits dug by these squirrels apparently when they are after larvæ or perhaps edible roots. Throughout the summer, but especially during the last half of the season, and in autumn Douglas squirrels work with persistent energy to amass great stores

XUM

LITTLE SPOTTED SKUNK
Spilogale putorius

COMMON SKUNK
Mephitis mephitis

HOG-NOSED SKUNK
Conepatus mesoleucus



NINE-BANDED ARMADILLO
Dasypus novemcincta

XUM

of seed-bearing cones, which they heap, sometimes bushels of them, about the bases of trees, stumps, and the upturned roots of fallen trees or under other shelter. Cones are also buried here and there in the loose leaves and humus. In winter many holes in the snow with piles of cone scales at the entrances show where the owners have dug down to their stores.

Some of their nests are constructed in hollow trees, many others on branches near their junction with the trunks, and still others in underground dens under roots, logs, or stumps. In winter when alarmed these squirrels sometimes race down the tree trunks and take refuge in holes leading through the snow to their food caches and underground burrows. The nests built in tree-tops are usually rather bulky, measuring a foot or more in diameter, and are made of small twigs, dry leaves, moss, grass, and fibrous bark. They are commonly lined with such soft material as feathers and fur. The young, numbering three to seven at a litter, are born at any time between April and October.

The extraordinary intelligence and sense of prevision possessed by squirrels of this group is well illustrated by certain local food migrations. These have been observed in eastern Oregon in years when the cone crop has failed and nothing was available to lay up for winter. Under such conditions to remain in the mountain forests would mean death by starvation before winter had fairly begun. In 1910 and 1913 failure of the cone crop occurred in eastern Oregon and these squirrels promptly left the mountain forests in September and descended along creek courses to the open sagebrush plains as much as seven or more miles from the border of their ordinary haunts. In this open country they wintered successfully, raiding the farmers' grain bins, root cellars, and other stores, and otherwise showing their supreme fitness to survive in the struggle for existence. With the coming again of summer they promptly returned to their abandoned homes in the pines. It appears to be one of the marvels of animal intelligence that under such circumstances as those named above the entire body of the squirrels on the mountains should have known what to do, especially as a great percentage of their number could never have had any previous experience as a guide.

THE GRAY SQUIRREL (Sciurus carolinensis and its relatives)

(*For illustration, see page 445*)

The gray squirrel is so well known to everyone in the Eastern States that it scarcely needs an introduction. Many who have not seen it in its native haunts are familiar with it as a graceful and charming resident of parks in many cities. It is about twice as large as the red squirrel and intermediate in size between that species and the fox squirrel. Although sharing some of the range of both the species named, the color of the gray squirrel at once distinguishes it.

The gray squirrel is a North American species with no near relative in the Old World; on the Pacific coast, in the mountains of the Southwest, and in Mexico are other squirrels having much the same gray-colored body, but with no close relationship to it. Its range covers the deciduous forests of the Eastern States and southern Canada from Nova Scotia to Florida, and westward to the border of the treeless Great Plains. Wherever they occur these squirrels are an attractive element in the woodland life, their barking and chattering, their graceful forms, and their activity adding greatly to the cheerful animation of the forest. They are far less vociferous than red squirrels, but their notes are varied and serve to express a variety of meanings.

During the early settlement of the country west of the States bordering the coast, gray squirrels existed in great numbers and often made ruinous inroads on the pioneer corn and wheat fields. In 1749 they invaded Pennsylvania in such hosts that a bounty of three pence each was put on their scalps. Eight thousand pounds sterling was paid on this account, which involved the killing of 640,000 squirrels. In 1808 a law in force in Ohio required that each free white male deliver 100 squirrel scalps a year or pay $3 in cash. Records of the ravages of these squirrels in corn fields are extant also from Kentucky, Missouri, and other States.

Enormous migrations of gray squirrels from one part of the country to another occurred in those days, caused apparently by the failure of food supplies in the deserted areas. Some impulse to move in one general direction at the same time appeared to affect the squirrels and they swarmed across country in amazing numbers, carrying devastation to any farms crossed on the way. When engaged in such movements they appeared indifferent to obstacles and without hesitation swam lakes and streams even as large as the Hudson and the Ohio. Amusing legends grew up concerning these migrations, one of which avers that when the squirrels arrived on a river bank each dragged a large chip or piece of bark into the water and mounting it raised its bushy tail in the breeze and was wafted safely to the other shore! As a fact, many were drowned in crossing large streams and others arrived exhausted from their exertions.

The gray and fox squirrels were favorite targets for pioneer marksmen. The early chronicles tell of the ability of Daniel Boone and other riflemen to "bark" a squirrel, which meant so to cut the bark of the branch on which the squirrel sat as to bring it to the ground stunned without hitting the animal. With the clearing away of the forests, the general occupation of the country, and the decrease of larger animals, gray squirrels have been deprived of most of their haunts and have become such desirable game that they have decreased to a point requiring stringent legal protection to save them from extermination.

Gray squirrels are more thoroughly arboreal than red squirrels and make their nests either

in hollow trunks or build them in the tops of trees. These outside nests are common and much like a crow's nest in appearance except that they are generally more bulky and show more dead leaves. They are built on a foundation of small sticks with a rounded top of leaves, and are lined with shreds of bark, moss, and similar soft material. In the extreme northern part of their range they live mainly in hollow trees, but farther south many winter in outside nests. During severe cold and in stormy weather they remain hidden, sometimes for days at a time.

They have two litters of four to six young a year, the first usually being born in March or April. The old squirrel is a devoted mother and if the nest is disturbed she will at once carry the young to some safer retreat.

In many parts of their range black, or melanistic, individuals are born in litters otherwise of the ordinary gray color. In some districts the number of the black squirrels equals or exceeds the gray ones.

Gray squirrels range through such a variety of climatic conditions that their food varies greatly. They eat practically all available nuts, including acorns, chestnuts, beechnuts, hickory-nuts, and pecans, besides numberless seeds, many small fruits, and mushrooms. They raid fields for corn and wheat, and steal apples, pears, and quinces from orchards to eat the seeds. Like most other small rodents, they are fond of larvæ and insects and also destroy many birds' eggs and young birds. They are far less serious offenders, however, in destroying birds than the red squirrel.

On the approach of winter they lay up stores of seeds and nuts in holes in trees and in little hiding places on the ground. Many nuts are hidden away singly. In the public parks of Washington, where many gray squirrels exist, I have repeatedly seen them dig a little pit two or three inches deep, then push a nut well down it, cover it with earth, which they press firmly in place with the front feet, and then pull loose grass over the spot. One squirrel will have many such hidden nuts, and with nothing to mark the location it appears impossible that they could be recovered. That the squirrels knew what they were doing I have had repeated evidence in winter, even with several inches of snow on the ground, when they have been seen sniffing along the top of the snow, suddenly stop, dig down and unearth a nut with a precision that demonstrates the marvelous delicacy of their sense of smell. Although mainly diurnal, they are sometimes abroad on moonlight nights, especially when gathering stores of food for winter.

Wherever they are, these squirrels are extremely graceful, moving along the ground by curving bounds, the long fluffy tail undulating as they go, or running through the tree-tops, leaping from branch to branch with an ease and certainty beautiful to see. When pressed they make amazing leaps from tree to tree or even from a high tree-top to the ground without injury. They are extremely cunning at concealing themselves by lying flat on top of branches or by gliding around tree trunks, keeping them interposed between themselves and the pursuer.

Gray squirrels are so responsive to protection that they may continue to grace our remaining forests if we properly guard them. In addition to their beauty, they are interesting game animals which should continue to afford a moderate amount of sport—sufficient to prevent them from becoming overabundant and destructive. Now introduced in many city parks throughout the United States and in parts of England, including London, their ready acceptance of people as friends renders them charming animals in such places; but natural food is so scarce under these artificial conditions that care must be taken to feed them at all seasons, especially in winter.

THE FOX SQUIRREL (Sciurus niger and its relatives)

(*For illustration, see page 445*)

THE RUSTY FOX SQUIRREL (Sciurus niger rufiventer)

(*For illustration, see page 445*)

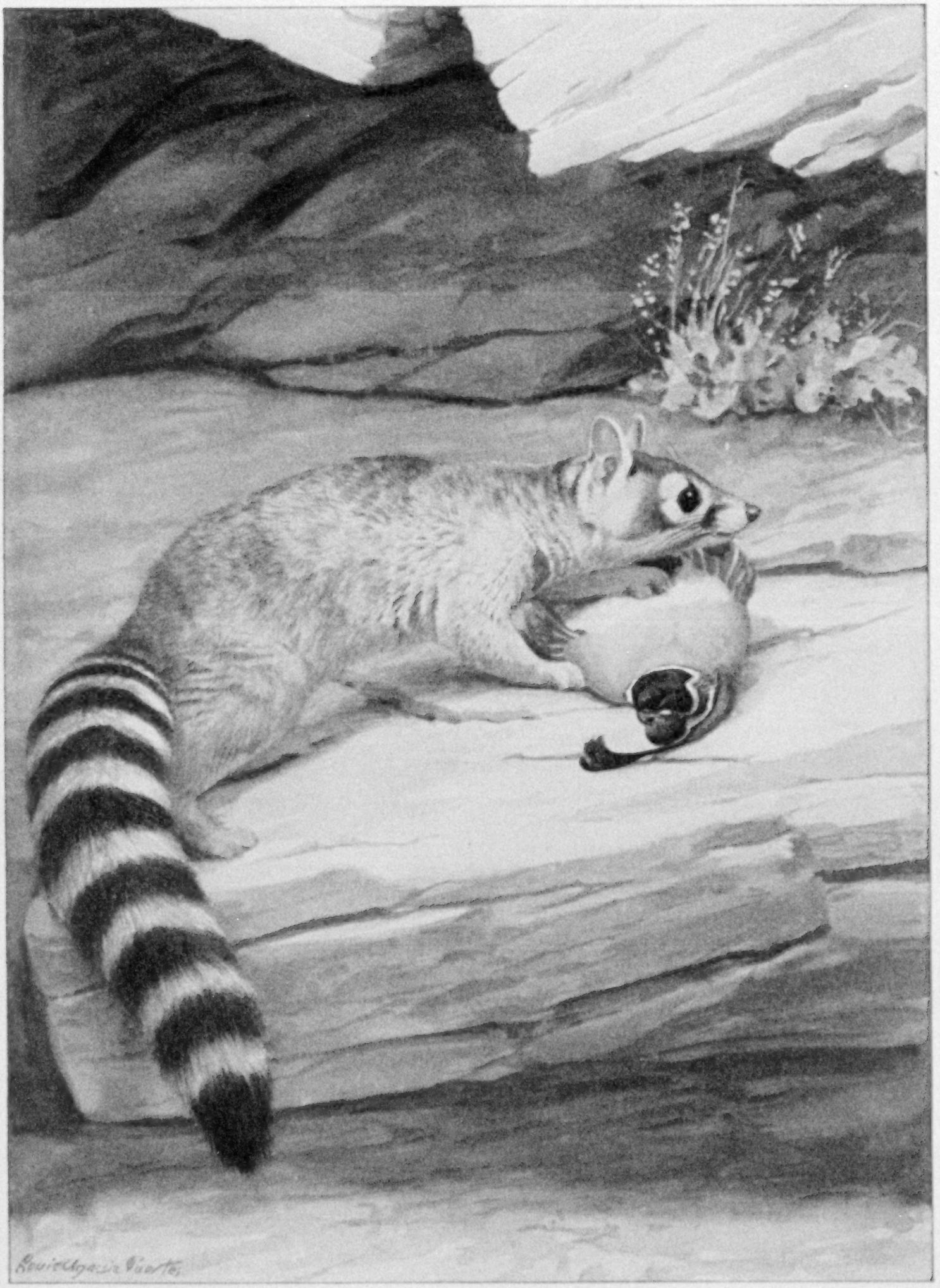
Three species of tree squirrels inhabit the varied forests of eastern North America, each having its marked individuality expressed in color, size, and habits. All occupy a wide territory with varying climatic conditions, to which each species has responded by becoming modified into a series of geographic races, or subspecies. The red and the gray squirrels have already been described and it remains to give an account of the largest and in some respects the most remarkable of the three, the fox squirrel.

No other species of North American mammal can show such an extraordinary contrast in color among its subspecies as that between the rusty yellowish animal of the Ohio and upper Mississippi Valleys, and the handsome blackish one of the Southeastern States, both of which are pictured in the accompanying illustration.

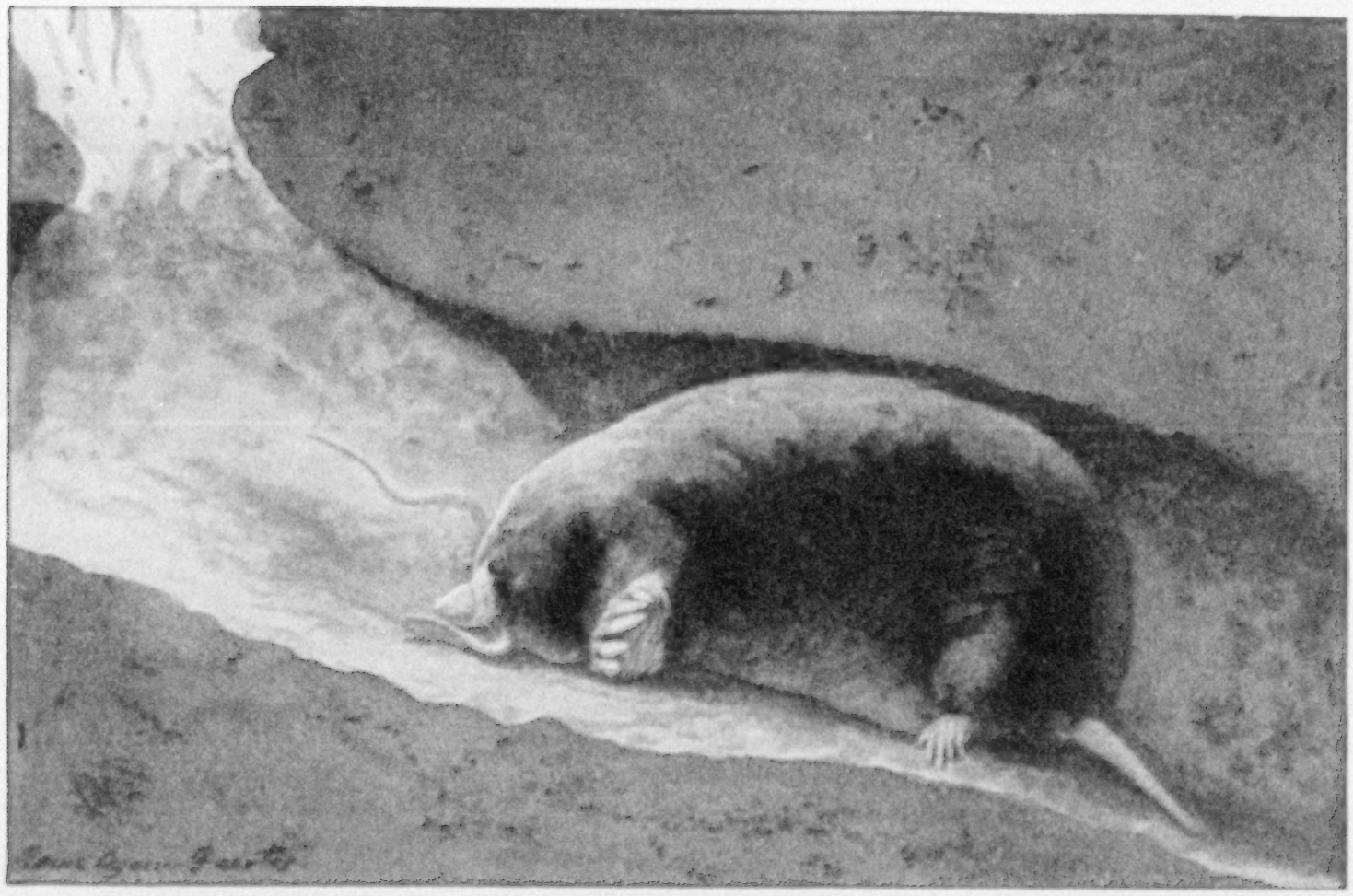
The distribution of the fox squirrel is limited to the forested parts of the Eastern States. There it ranges from the Atlantic coast to the border of the Great Plains, and from southern New York and the upper Mississippi Valley southward to Florida, the Gulf coast, and across the lower Rio Grande into extreme northeastern Mexico.

Variations in the character of the haunts of the different subspecies of this squirrel almost equal their differences in color. In the upper Mississippi and Ohio Valleys the rusty-colored race frequents the upland woods, where the nut-bearing hickory trees characterize the forests. In the South the dark-colored squirrels have more varied homes, either amid the live oaks draped in long Spanish moss, in the mysterious cypress forests of the swamps, or out in the uplands among the southern pines.

XUM



RING-TAILED CAT
Bassariscus astutus



OREGON MOLE
Scapanus townsendi

STAR-NOSED MOLE
Condylura cristata

In early days fox squirrels were plentiful, but never equaled the numbers of the gray squirrel. They appear always to have been more closely attached to their own district, for we have no records of the great migrations so notable in the other species.

Fox squirrels are not only distinguished from gray squirrels by their color, but are also nearly twice their size, commonly attaining a weight of two and sometimes nearly three pounds. They are the strongest and most heavily proportioned of all American squirrels. A deliberation of movement going with heaviness of body is in marked contrast to the graceful agility of most other tree squirrels. On the ground they walk with a curiously awkward, waddling gait, and even when hard pressed climb trees with none of the dashing quickness shown by other species. They often move about on the ground by a series of bounds, and at such times, with broad, feathery tails undulating in the air, present a most graceful and attractive sight.

Fox and gray squirrels occupy the same districts throughout most of their ranges, but often become so segregated locally that the grays may be found almost exclusively along bottom-lands and the fox squirrels on the higher ridges, but there is no hard and fast separation of haunts and the two forms usually share the same woodlands.

Much time is spent by fox squirrels on the ground searching for food. When danger approaches, in place of promptly taking refuge in a tree, as is a common habit with most tree squirrels, they retreat along the ground, mounting a stump or log now and then, to look back at a suspected intruder, whose footsteps they can hear at a long distance. If the hunter is without a dog they may run away and be lost. A dog soon forces them up a tree and if a knot-hole or other hollow is available they at once take refuge in it. Otherwise they hide skillfully in bunches of leaves high in the top or lie flat on a limb or against the trunk, slyly moving to keep on the opposite side as the hunter draws near. In the Mississippi Valley during the crisp days when the hickory nuts are falling and the trees are decked in all the glories of autumn foliage, few sports afield yield more pleasurable sensations than fox-squirrel hunting.

The fox squirrels become fatter than most of their kind and their flesh is not so dry, although all furnish appetizing meat. Owing to their size and the quality of their flesh, they have been such desirable game animals that with the constantly growing number of hunters and the destruction of forests they have already disappeared from large areas where formerly abundant and are in real danger of extermination in the not-distant future. They are among the most notable and attractive of the forest animals in the Eastern States, and before it is too late every effort should be made to protect them from overshooting. With reasonable conservation they will continue to thrive and keep some of the old-time primitive spirit in our woods. Formerly they had the same predilection as the gray squirrel for the farmers' corn fields and were under the ban, but their numbers are now so reduced that they give little trouble in this way. In some city parks where they have been introduced, they soon become tame and do well, except that in losing their fear of man they become subject to many accidents.

Fox squirrels, like many others of their kind, have homes both in knot-holes or other hollows in tree trunks, and in bulky nests of sticks and leaves high up among the branches. Both kinds of nesting places are often located in the same tree, the owner living in the outside nest in warm weather and retiring to the shelter of the hollow trunk in severe weather or to escape an enemy. The young, two to four in number, are usually born in March or April, and it is not definitely known whether there is a second litter. These squirrels have a barking call as well as several other rather deep-toned chucking notes.

They are as omnivorous as any of their kind, eating many kinds of nuts, seeds, fruits, mushrooms, insects, birds, birds' eggs, and other flesh food when available. The principal nuts in their haunts are hickory-nuts, beechnuts, walnuts, pecan nuts, and the seeds of pines and cypresses. Toward the end of summer and in fall they work busily gathering and storing food for winter in hollow trees, in old logs, about the roots of trees, and in any other snug place where it may be kept safely until needed. Many single nuts are buried here and there in little pits three or four inches deep dug in the soft surface of the earth under the trees. These scattered stores are located when needed by the acute sense of smell which the owners possess.

THE ABERT SQUIRREL (Sciurus aberti and its subspecies)

(For illustration, see page 448)

THE KAIBAB SQUIRREL (Sciurus kaibabensis)

(For illustration, see page 448)

Among the many kinds of squirrels which lend animation and charm to the forests of North and South America, none equal in beauty the subjects of this sketch—the Abert and the Kaibab squirrels. These are the only American squirrels endowed with conspicuous ear tufts, which character they share with the squirrels occupying the forests in the northern parts of the Old World from England to Japan. In weight they about equal a large gray squirrel, but are shorter and distinctly more heavily proportioned, with broader and more feathery tails.

Their range covers the pine-forested region of the southern Rocky Mountains in the United States and the Sierra Madre of western Mexico. The Abert squirrel and its several subspecies is the more widely distributed, being found from northern Colorado, south through

New Mexico, Arizona, Chihuahua, and Durango. The Kaibab squirrel, which is even more beautiful than its relative, shows marked differences in appearance and yet is evidently derived from the same species.

The typical Abert squirrel lives in the pine forests along the southern rim of the Grand Canyon in northern Arizona, and the Kaibab squirrel lives in the pines visible on the northern rim of the canyon less than 15 miles away. It is confined to an islandlike area of pine forest above 70 miles long by 35 miles wide, on the north side of the canyon, on the Kaibab and Powell plateaus, directly across from the end of the railroad at the Grand Canyon Hotel. The two species live under practically identical conditions as to vegetation and climate.

In these sketches of our mammal life I have repeatedly noted the effect of changing environment in modifying the animals subject to it. In the present case the change in the squirrels on the north side of the Grand Canyon has evidently been brought about by that powerful factor in evolution known as isolation. Cut off from their fellows by the deepening canyon of the Colorado, Kaibab squirrels have occupied a forest island ever since, with the resulting change in characters we now have in evidence.

The home of both the Abert and the Kaibab squirrels is almost entirely between 6,000 and 9,500 feet altitude, on the mountain slopes and high plateaus overgrown with a splendid open forest of yellow pine mixed in many places with firs and aspens. Occasionally, as food becomes scarce in their ordinary haunts, they range up into the firs or down into the oaks and piñon pines. In winter their haunts are buried in snow, but in summer on every hand present lovely vistas among the massive tree trunks, varied here and there by gemlike parks. Everywhere the ground is covered with grasses and multitudes of flowering plants. In the wilder parts of this fascinating wilderness roam bears, mountain lions, wolves, deer, and wild turkeys, and only a few decades ago still wilder men, belonging to some of our most dreaded Indian tribes.

Although these squirrels commonly make use of large knot-holes or other hollows in trees, they regularly build high up in the branches bulky nests of leaves, pine needles, and twigs and line them with soft grass and shredded bark. Sometimes several full-grown squirrels may be found occupying one of these outside nests, probably members of one family. They are active throughout the year, but remain in their nests during storms and severe winter weather. In northern Arizona I have known them to stay under cover for a week or two at a time in midwinter.

The young appear to be born at varying times between April and September. Although not definitely known, it seems probable that they have two litters of from three to four young each season.

The seeds and the tender bark from the terminal twigs of the yellow pine (*Pinus ponderosa*) furnish their principal food supply. During periods when pine seeds are not available the squirrels cut the ends of pine twigs, letting the terminal part bearing the leaves fall to the ground, while the stem, several inches in length, is stripped of bark. Often at times of food scarcity the bark will be eaten for a considerable distance along the outer branches, almost like the work of porcupines. The ground under the pines where the squirrels are at work is sometimes almost covered with the freshly dropped tips of branches.

The Abert squirrels also eat the seeds of Douglas spruce, of the piñon pine, acorns, many seeds, roots, green vegetation, mushrooms, birds' eggs, and young birds. Now and then they rob cornfields planted in clearings, but they do little damage to crops. Some years they are extremely numerous and are in evidence everywhere; again they become scarce and so wary that it is difficult to see one, even where its fresh workings are in evidence.

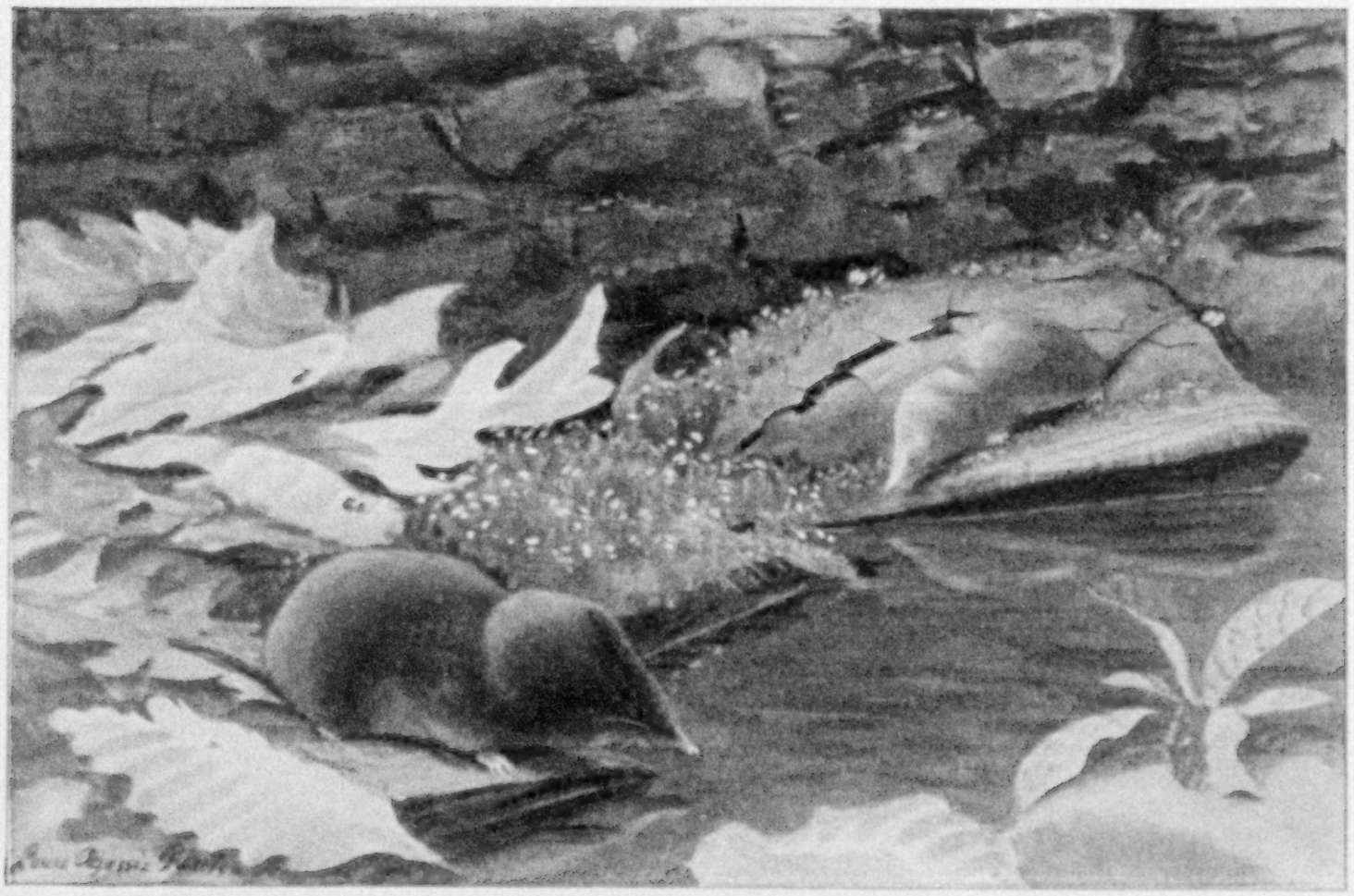
Both these squirrels have a deep churring or chucking call, sometimes becoming a barking note resembling that of the fox squirrel. They also have a variety of chattering and scolding notes when excited or angry. At times they become almost as aggressive as the red squirrel and come down the tree trunk or to a lower branch, whence they scold and berate the object of their disapproval.

When much alarmed they are expert at hiding among tufts of leaves near the ends of branches, on tops of large limbs, or behind trunks. They will remain hidden in this way for an hour or more, patiently waiting for the danger to disappear, but one is often betrayed by the wind blowing the feathery tip of its tail into view.

On the ground the tail is usually carried upraised in graceful curves. Here these squirrels spend much time among fallen cones and in digging for roots and other food. When they walk they have an awkward waddling gait, but when they are alarmed, or desire to move more rapidly for any cause, they progress in a series of extremely graceful bounds, which show the plumelike tail to good advantage. When the Kaibab squirrel is moving about on the ground its great white tail is extraordinarily conspicuous in the sunshine. This repeatedly drew my attention to these squirrels, even at such long distances that they would otherwise have been overlooked.

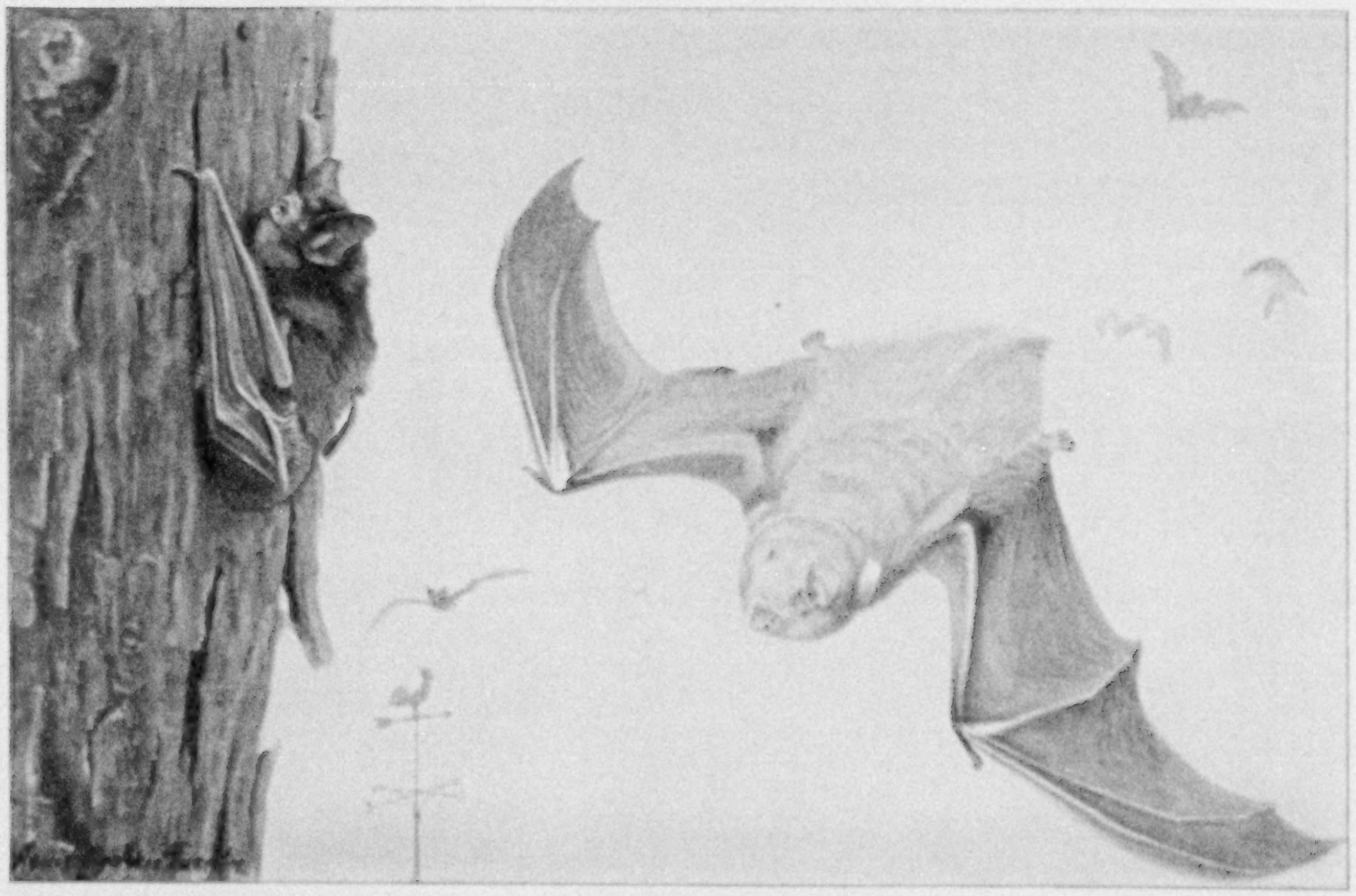
Although so heavily built, these squirrels are adept in leaping from branch to branch and from tree to tree. On one occasion a branch on which an Abert squirrel was standing near the top of a pine tree was struck by a rifle ball; the squirrel promptly ran to the end of a large branch about fifty feet from the ground, and although no tree was anywhere near on that side, leaped straight out into the air, with its legs outspread just as in a flying squirrel. It came down in a horizontal position and struck the ground flat on its under side and the rebound raised it several inches. Without an instant's delay it was running at full speed across a little open park and disappeared in the forest

XUM



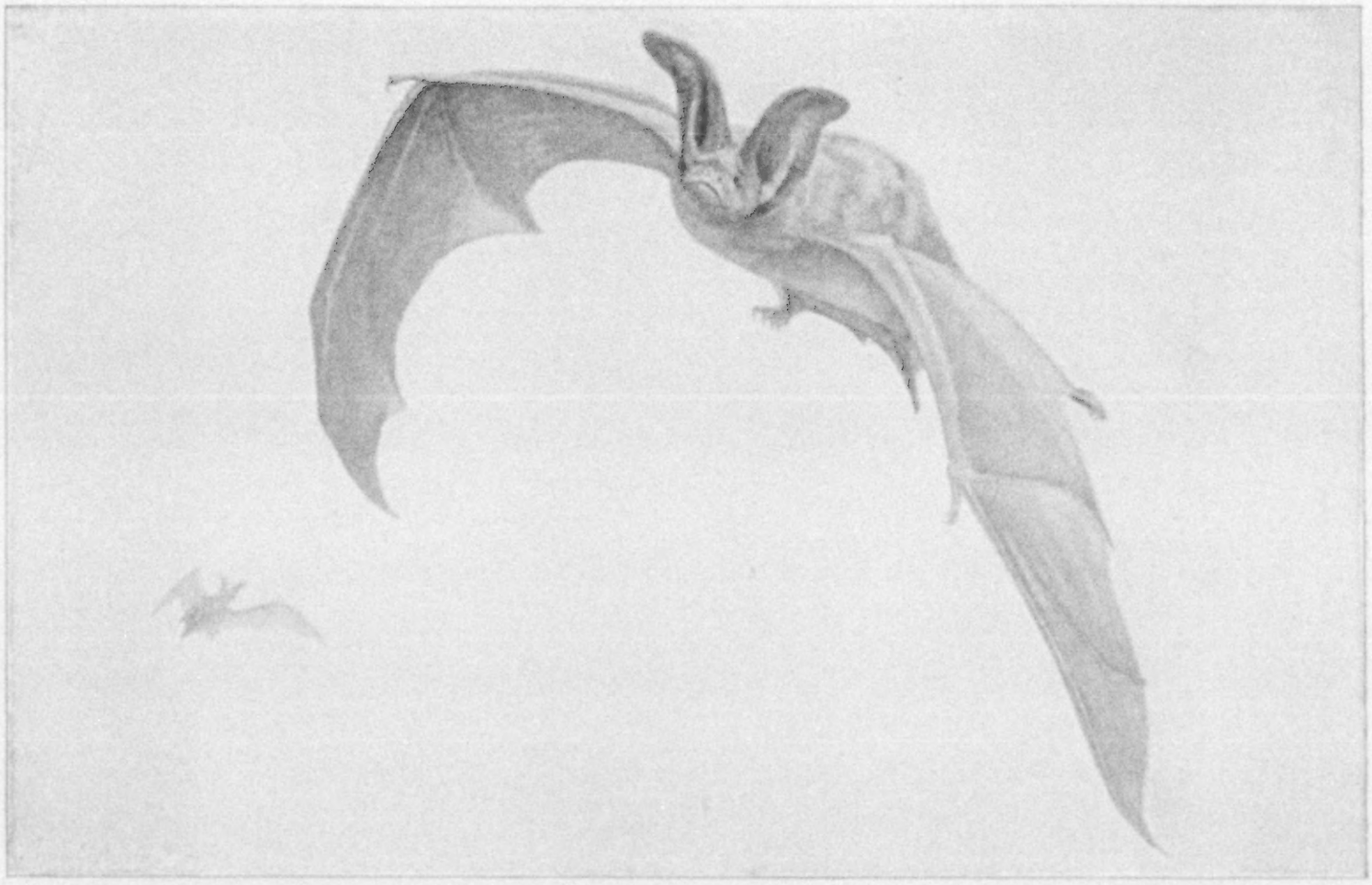
SHORT-TAILED SHREW
Blarina brevicauda

COMMON SHREW
Sorex personatus



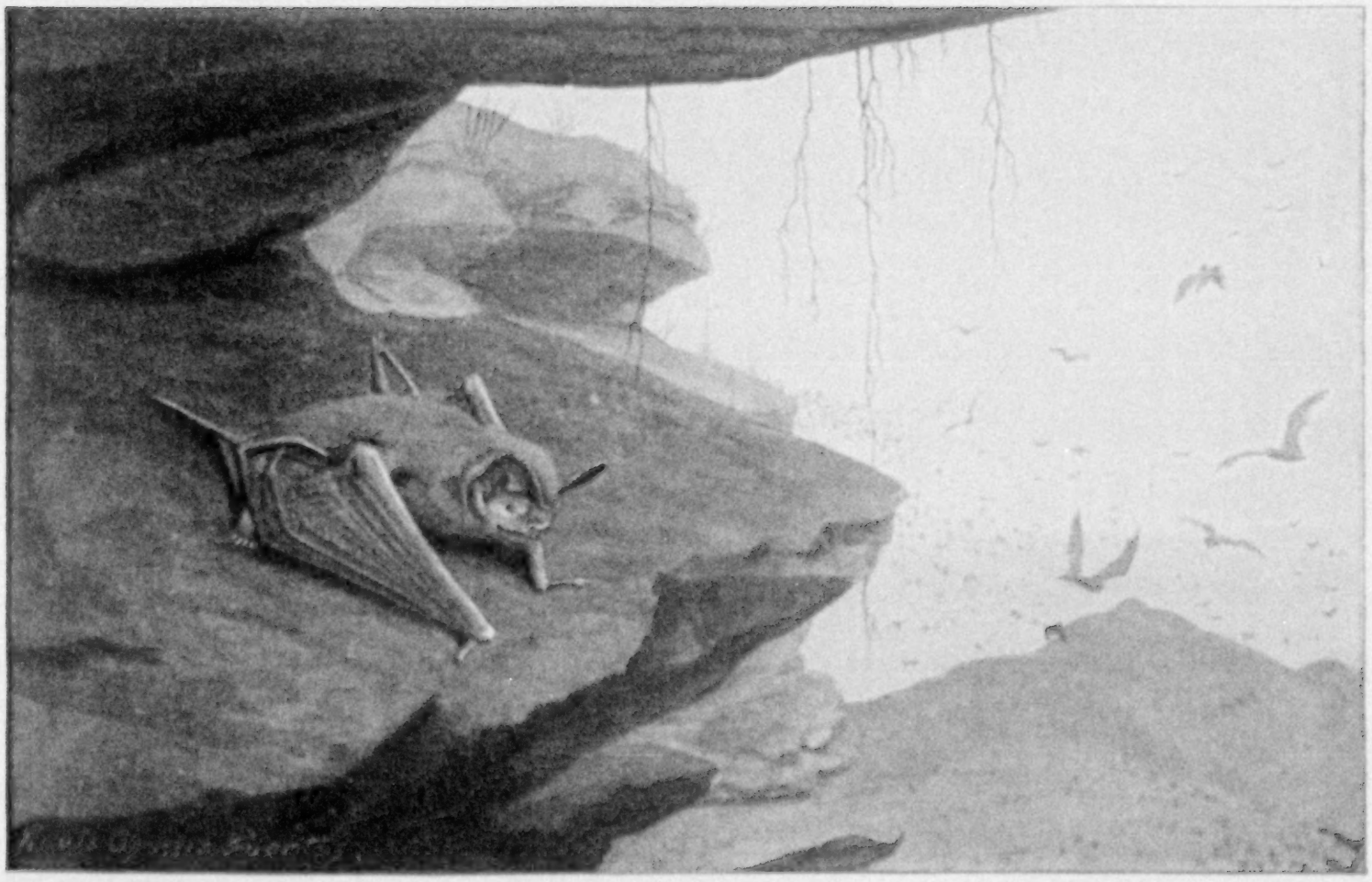
HOARY BAT
Nycteris cinereus

RED BAT
Nycteris borealis



BIG-EARED DESERT BAT

Antrozous pallidus



MEXICAN BAT

Nyctinomus mexicanus

XUM

on the other side. I was standing only a few yards to one side of the falling squirrel and the widely spread feet and legs were perfectly outlined against the sky. It was evident that this squirrel and probably all of its kind appreciate that such an attitude will help break the force of the descent. This suggested the possibility of a similar habit having influenced the origin of the flying squirrel's membranes.

One summer day in the Sierra Madre of western Durango I sat on a mountain slope watching for game. Below me stood the hollow-topped stub of an oak, the top being on a level with my eyes and about twenty yards away. Soon after I arrived the heads of four half-grown squirrels of the Abert family appeared in a row at the upper border of the opening, their bright eyes turning on all sides. Suddenly a hawk glided by, one of its wing tips almost brushing the noses of the squirrels. Instantly they vanished from sight and a noise of scratching and frightened chattering continued for several minutes, as though they were burying themselves under the nest. About twenty minutes later the boldest of the family showed the tip of his nose at an opening in a hollow branch near the top of the stub, but it required another ten minutes for him to venture forth his head. Finally, becoming confident that no danger threatened, he came out on the limb and deliberately stretched himself, yawning as widely as his little mouth would permit, after which he flirted his tail and frisked over to the trunk of the stub, where he began frolicking about with all the abandon of a kitten at play. When I departed his more timorous companions were still peering fearfully out of the hole, anticipating the return of the dreaded hawk.

THE FLYING SQUIRREL (Glaucomys volans and its relatives)

(*For illustration, see page 449*)

No one can see one of our small flying squirrels in life without being charmed by its delicate grace of form and velvety fur, nor fail to note the large black eyes which give it a pleasing air of lively intelligence. Flying squirrels are distinguished from all other members of the squirrel family by extensions of the skin along the sides, which unite the front and hind legs, so that when the animal leaps from some elevated point with legs outspread the membrane and the underside of the body present a broad, flat surface to the air. This enables it to glide swiftly down in a diagonal course toward a tree trunk or other vertical surface on which it desires to alight. It is able to control its movements and to turn with ease to one side or the other, or upward before alighting. When gliding down a wooded hillside or through thick growths of timber, it is thus able to avoid obstacles and alight on the desired place.

Flying squirrels are circumpolar in distribution. In the Old World they occupy forested areas in eastern Europe, and nearly all of Asia. In the New World they are peculiar to North America, where they frequent nearly all the wooded parts from the Arctic Circle to the Mexican border, and in forests in Mexico along the eastern border of the highlands as well as through Chiapas and Guatemala. In Asia, the center of development of these interesting rodents, many extraordinary forms occur. Some are giants of their kind, measuring nearly four feet in total length. In America there are two groups of species, the smaller and better known of which, the subject of this sketch, occupies the eastern United States and southward. The northern and western animals are larger, some of them more than twice the weight of the eastern species.

In many parts of the United States flying squirrels are common and even abundant, but their habits are so strictly nocturnal that they are infrequently seen. They make their homes in woodpecker holes, knot-holes, and hollows in limbs, and trunks of trees and stubs. In addition they take possession of many odd places for residence, among which may be mentioned bird-boxes, dove-cotes, attics, cupboards, boxes, and other nooks in occupied or unoccupied houses that are located within or at the borders of woods.

They also make nests of leaves, lining them with fine fibrous bark, grass, moss, fur, or other soft material placed securely in the branches or in forks in trees. They often remodel old bird or squirrel nests into snug homes for themselves. The size and construction of these outside nests vary according to the locality and the material available.

As a rule, the nests are small and accommodate only a single pair with their young, and sometimes hold only a single individual, but numerous exceptions to this have been observed. In southern Illinois fifty flying squirrels were discovered in one nest in a tree; in Indiana fifteen were found in a hollow stump; and near Philadelphia thirty were evicted from a martin box they had usurped.

In the southern part of their range flying squirrels are active throughout the year, but in the North they become more or less sluggish if they do not actually reach the stage of real hibernation during the severest weather.

Their food is extremely varied and includes whatever nuts grow in their haunts, as beechnuts, pecans, acorns, and others, with many kinds of seeds, including corn gathered in the field, and buds, and fruits of many kinds. They also eat many insects, larvæ, birds and their eggs, and meat. Taking advantage of their known liking for bird flesh, they may frequently be caught by concealing a trap on top of a log in the woods and scattering bird feathers over and about it. Trappers for marten and other forest fur-bearers are much annoyed in winter by the persistence with which the flying squirrels search out their traps and become caught in them, thus forestalling a more valued capture. Trappers in Montana who run long lines of traps for marten through the mountain forests capture hundreds of these squirrels in a single season.

XUM

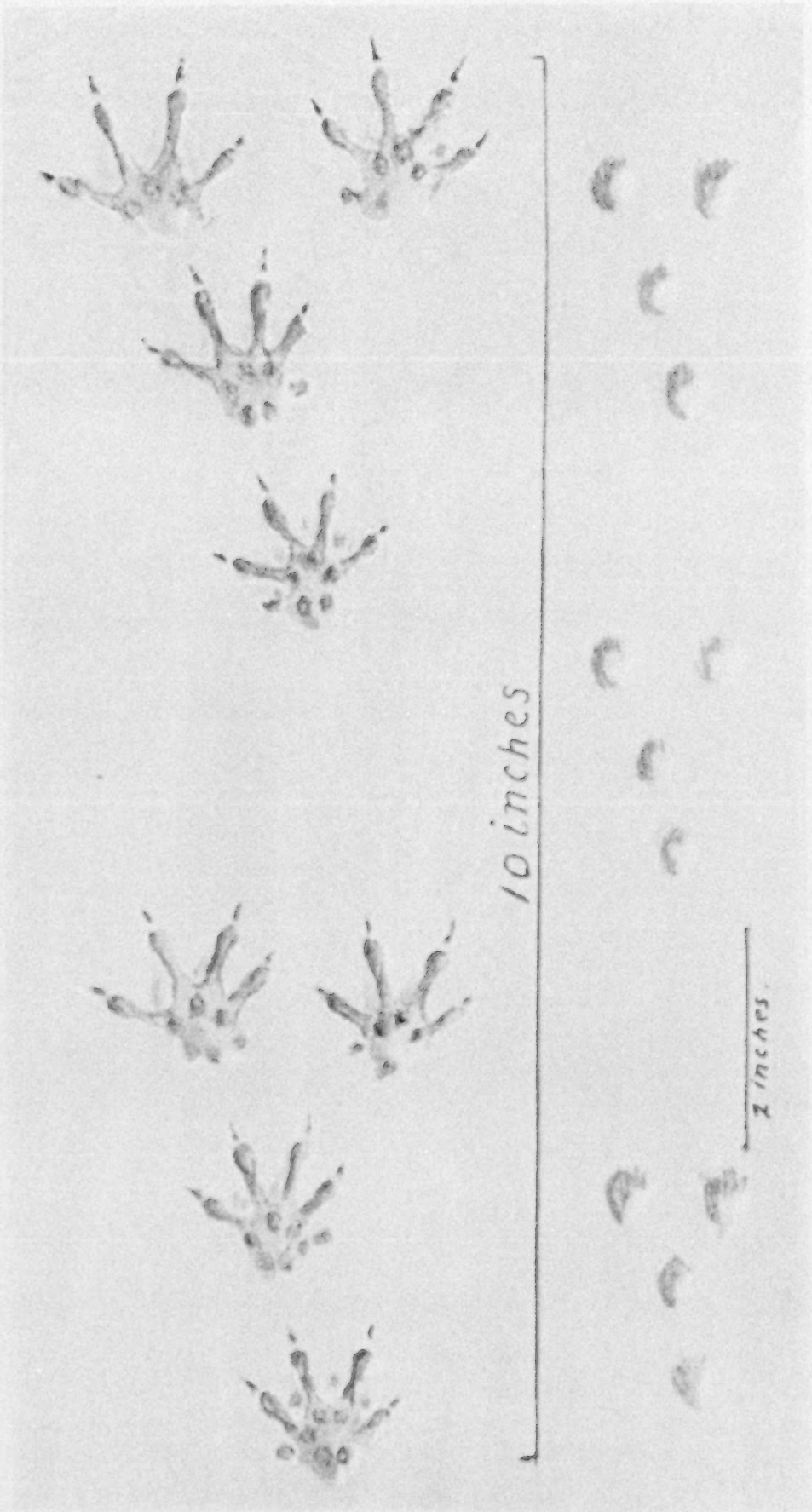
Flying squirrels have several notes, one of which is an ordinary *chuck, chuck,* much like that of other squirrels. They also utter sharp squeaks and squeals when angry or much alarmed, and a clear musical chirping note, birdlike in character, which is frequently repeated for several minutes in succession and is undoubtedly a song.

These beautiful little animals become the most delightful of pets, as they are notable for extraordinary playfulness and a readiness to accept man as a friend. Many interesting accounts have been published concerning the affectionate attachment they form for their human hosts and the amusing and tireless activity they show at night. By day they remain sound asleep, rolled up in a furry ball in some dark corner.

They are known to have a litter of from two to six young in April, and young are born at various times throughout the summer, but it is still unsettled whether there is more than one litter a year. The mother is devoted to the young, and if driven from them will keep close by at the risk of her life, showing much anxiety and readiness to do what she can to protect them. One instance well illustrates this maternal care. From a nest in a hollow stub the helpless young were taken and placed on the ground at its base, while the despoiler of the home stood by to observe the result. The mother soon returned and not finding her family in the nest promptly located them on the ground. Quickly descending, she took one in her mouth, carried it to the top of the stub and, launching into the air, sailed to a tree thirty feet away, up which she carried her baby and

THE TRAIL OF THE MUSKRAT

The usual gait of the muskrat on land is a slow walk. The tail mark is always very strongly shown (see pages 411 and 424).



THE TRACKS OF A GRASSHOPPER MOUSE

The anatomy of the foot is fairly well shown in the track—the insignificant thumb and the tubercles on the soles. The placing of the fore feet, one behind the other, indicates that the creature cannot climb a tree. The tail seldom or never shows. The original of this was in fine dust. The small tracks to the right show the style usually seen. There are many species of grasshopper mouse, but the tracks are not distinguishable from each other. The exact species is determined by locality, size, etc. (see pages 418 and 425).

placed it safely in a knot-hole. The trip was quickly repeated until the family was reunited in its new location.

At night the curiosity of flying squirrels about strange things and their mischievous activities are often most entertaining, and sometimes exasperating. Whatever is accessible within their territory is certain to be thoroughly explored. A large apartment building, seven stories high, in Washington stands on the border of the woods of the Zoological Park. During one summer night a friend occupying an apartment on the seventh floor of this building, fronting the park, observed some movement on one of his window sills and by later observation and by inquiry among the other residents learned that flying squirrels were habitually climbing all about the high walls to the top of this building, using it and some of the rooms as a nightly playground. Several occupants of apartments in different parts of the building regularly placed nuts of various kinds on the window ledges for them, and now and then were amused to find that during the night the squirrels had carried away some of their nuts, but had replaced them with other kinds, sometimes brought from a window at a considerable distance on another side of the building. The presence of these squirrels was warmly welcomed and furnished much interest to their hosts.

The constant activity of these little animals at night enables owls and cats to capture many, but their small size and the shelter of their homes by day will prevent their serious decrease in numbers so long as suitable forests remain to supply their needs.

THE BLACK-FOOTED FERRET
(**Mustela nigripes** and its relatives)

(*For illustration, see page 449*)

Of all the varied forms of mammalian life in America, the black-footed ferret has always impressed me as one of the strangest and most like a stranded exotic. It is about the size of a mink, but, as the illustration shows, is entirely different in appearance and has the general form of a giant weasel. It has no close relative in America, but bears an extraordinarily close resemblance in size, form, and color to the Siberian ferret (*Mustela eversmanni*).

The black-footed ferret occurs only in the interior of the United States, closely restricted to the area inhabited by prairie-dogs, from the Rocky Mountains eastward and from Montana and the Dakotas to western Texas. It is known also west of the mountains in Colorado. Like others of the weasel tribe, it must have a wandering disposition, since one was captured at 9,800 feet altitude, and another was found drowned at 10,250 feet in Lake Moraine, Colorado.

These ferrets exist as parasites in the prairie-dog colonies, making their homes in deserted burrows and feeding on the hapless colonists. In Kansas their presence in certain localities appears to have been effective in exterminating prairie-dogs, and similar activities may account for the deserted "dog towns" which are not infrequently observed on the plains with no apparent reason for the absence of the habitants.

They do not appear to be numerous in any part of their range and little is known concerning their habits. Now and then they are seen moving about prairie-dog "towns," passing in and out of the burrows at all hours of the day, but it is probable that they are mainly nocturnal. This probability is strengthened by the extreme restlessness shown at night by captive animals. With the occupation of the country and the inevitable extinction of the prairie-dog over nearly or quite all of its range, the black-footed ferret is practically certain to disappear with its host species.

It has the same bold, inquisitive character shown by the weasel, and when its interest is excited will stand up on its hind legs and stretch its long neck to one side and another in an effort to satisfy its curiosity. When surprised in a "dog town" it commonly retreats to a burrow, but promptly turns and raises its head high out of the hole to observe the visitor. As a result ferrets are readily killed by hunters. When one is captured it will at first hiss and spit like a cat and fight viciously, but is not difficult to tame.

Although mainly dependent upon prairie-dogs for food, there is little doubt that ferrets, after the manner of their kind, also kill rabbits and other rodents in addition to taking whatever birds and birds' eggs may be secured. In one instance a black-footed ferret lived for several days under a wooden sidewalk in the border town of Hays, Kansas, where it killed the rats harboring there.

THE LARGE WEASELS, OR STOATS
(**Mustela arcticus** and its relatives)

(*For illustration, see page 452*)

The weasel family includes not only the true weasels, but numerous other carnivores, as the sable or marten, mink, ferret, skunk, and land and sea otters, all of which rank among our highly valued fur-bearers. The large weasel may be distinguished from others of its family by the small size and the snakelike proportions of the flattened and pointed head, combined with a long, extremely slender neck and body and a comparatively long tail. The best known of these animals are the stoat of the northern parts of the Old World (*Mustela erminea*) and its close relative in northern North America (*Mustela arcticus*), the winter skins of which furnish the famed ermine, once sacred to the trappings of royalty.

The northern weasels are strongly marked by their habit of changing their brown coat to one of snowy white at the beginning of winter. To the south the change becomes less complete as the winter snows decrease, and south of the limit of snow the brown coat is retained throughout the year. The time of change depends on the coming of the snow and varies with the year, and the time of resumption of the brown coat in spring depends in the same way on the season. The white winter coat of the larger and medium-sized species is accompanied by a strongly contrasting jet black tip to the tail.

Weasels are circumpolar in distribution and occupy nearly all parts of Europe, Asia, and North and South America, the greatest number and variety of species occurring in North America. Surprisingly enough, the largest of these eminently northern animals is found in the forests of the American tropics. The Arctic weasel ranges to the northernmost polar lands of North America, where its presence has been recorded many times by ice-bound explorers. Other species are more or less generally distributed over the remainder of the continent. In Mexico I have found them from sea level to above timberline, at more that 13,000 feet altitude on the high volcanoes.

The strong personality of the weasels as a group is based mainly on their extraordinary celerity of movement, their courage, and their insatiable desire to kill. They are not satisfied with supplying the call for food, but whenever opportunity arises kill from sheer lust of slaughter.

Their slender forms enable them to follow their prey to the remotest depths of their retreats, and that all rodents have an abiding horror of them is shown by the effect of a weasel's appearance. Rabbits, although many times their size, become easy victims, and in one instance when a large rat, which had fought its human captor viciously, was put in a cage with a weasel, it at once lost all its courage and permitted itself to be killed without an effort at defense.

Weasels are wonderfully endowed for their

XUM

FOOTPRINTS OF A WHITE-FOOTED MOUSE

When reduced to scale, the large tracks on the left side are life size, showing the animal making the ordinary bounds of about 3 inches between each set of tracks. In speeding, the space may increase to 12 inches. The tail usually shows in the deermouse track, and this, with the pairing of the fore paws, is a strong characteristic (see pages 419 and 428).

predatory work and are undoubtedly the most perfectly organized machines for killing that have been developed among mammals. Their keen eyes are constantly alert to observe everything about them, their ears are attuned to catch the faintest squeak of a mouse or cry of any other small animal, and their powers of scent are very great. When hunting they dart in and out of the holes of rodents, among crevices in the rocks, or through brush piles, pausing now and then to stand upright on their hind feet, the head swaying to and fro as they peer about. The squeak of a mouse starts them instantly in search of it, and like a dog they trail rabbits and other rodents by scent.

As a rule, weasels are terrestrial, but in wooded country they climb trees and leap from branch to branch with all the ease of squirrels. In most localities they are not common, but now and then, where conditions are peculiarly favorable, they become numerous. At one naturalist's camp in the upper Yukon they were surprisingly abundant, so much so that more than forty were caught in a few days in traps set among broken rocks. There they were extremely bold, hunting for their prey among the rocks within a few feet of the trappers.

The prey of weasels includes almost every kind of small rodent and bird living within their territory. They feed especially upon northern hares, cottontails, conies, ground squirrels, chipmunks, tree squirrels, wood rats, mice, lemmings, quail, ptarmigan, spruce and ruffed grouse, ducks, and numberless other small species. They are also very destructive to domestic fowl, often killing thirty or forty in a night. They unhesitatingly attack rodents many times their own weight.

Once when hunting on the open plain near the southern end of the Mexican table-land, I saw at some distance what appeared to be a brown ball rolling about on the ground. This was soon determined to be a weasel fastened to one of the large and powerful pocket gophers of that region. The weasel had its teeth set in the back of the neck of the gopher, while the latter was blindly trying to tear itself loose. I fired an ineffectual shot at the weasel and it vanished like a flash in the open tunnel of the gopher. As I drew near, the gopher, still in fighting mood, faced me with bared teeth. Later, when I removed its skin, I found that the weasel had torn loose the attachment of the heavy neck muscles to the back of the skull until only a thin layer remained to protect the spinal column. This had been accomplished without breaking the thin, but extremely tough, skin of the gopher.

When a weasel is attacking an animal which resists, like a large ground squirrel, it raises its head and sways its long neck back and forth, its eyes glittering with excitement as it watches for an opening to spring forward and seize its prey. Its attack is always aimed at a vital point, commonly the brain, the back of the neck, or the jugular vein on the side.

Weasels dig their own burrows under the shelter of slide rock, ledges, stone walls, stumps, and outbuildings, or they occupy hollow trees and the deserted burrows of other animals. In

nests thus safely located they have one litter containing an average of from four to six, but sometimes numbering up to twelve, young a year. They are born at any time from April to June, according to the latitude. The number of young in a litter is enough to render weasels very abundant, but this is rarely the case, and raises the question as to the influence which holds their number in check.

They are both nocturnal and diurnal, apparently in almost equal degree, since they are frequently observed hunting in the middle of the day, while their nocturnal raids on poultry houses testify to their activities at night. When hunting they appear like sinister shadows and are persistent in pursuit. The young commonly remain with the female until nearly or quite grown and follow her closely on hunting trips. It is interesting to see a pack of these deadly carnivores working, the mother leading and the young skirmishing on all sides, now spreading out, now closing in, like a pack of miniature hounds. On these family hunting parties, however, they usually keep close to the rocks, logs, brush, or other cover.

Themselves subject to the law of fang and claw, weasels are killed and eaten by wolves, coyotes, foxes, and various birds of prey. Their very lack of fear perhaps in many cases leads to their destruction.

These representatives of the primitive woodland life continue to occupy practically all of their original range. They visit farms in all parts of the country and I have seen them near the outskirts of Washington.

It is well that weasels are not abundant, for beasts with such innate ferocity and love of killing would otherwise be a menace to the existence of many useful species of birds and mammals, especially the game birds. In many places they live almost entirely on mice, and there they should be left unmolested; but whenever they locate in the vicinity of a chicken yard the owner will do well to take proper measures for protection.

THE LEAST WEASEL (Mustela rixosus and its relatives)

(*For illustration, see page 452*)

In addition to the larger members of the tribe briefly described in the foregoing sketch, the true weasels include another group of species, so small they may appropriately be termed the dwarfs of their kind. They vary from a half to less than a fourth the size of the larger weasels, but have the same characteristic form and proportions, except that the tail is very short and never tipped with black. Like the larger species, they change their brown summer coat for white at the beginning of winter and back again in spring.

The least weasels are also circumpolar in distribution, but are limited to the northern parts of Europe, Asia, and North America. In England and other parts of the Old World the group is represented by the well-known species *Mustela vulgaris*. In North America several species are known which, between them, share all the continent from the Arctic coast south to Nebraska and Pennsylvania. On the desolate islands extending from the mainland far toward the Pole their place seems to be taken by the ermine.

The dwarf weasels appear to be less numerous and, as a consequence, less known in most parts of America than in England and northern Europe. Our most northern species, *Mustela rixosa*, sometimes called the "mouse weasel," occupies Alaska and northern Canada and has the distinction of being the smallest known species of carnivore in the world. In this connection it is interesting to note that in Alaska we have associated on the same ground the least weasel and the great brown bear, the smallest and the largest living carnivores.

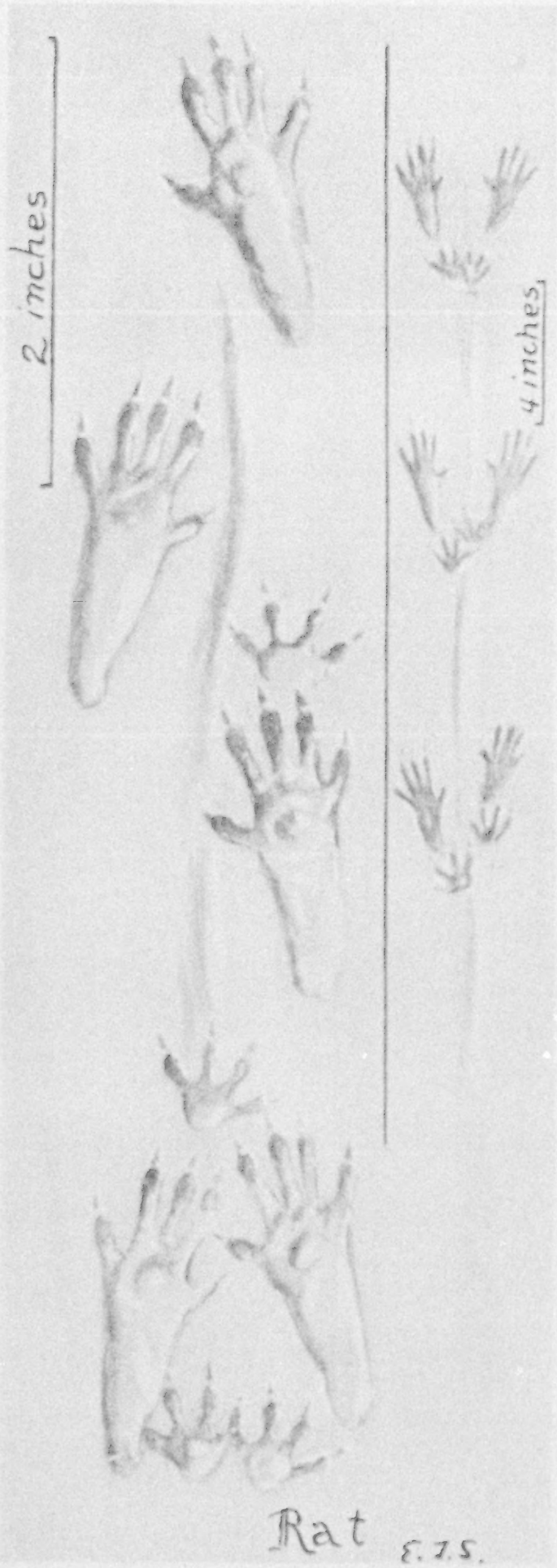
Least weasels are characterized by the same swift alertness and boldness so marked in the larger species. In fact they are, if possible, even quicker in their movements. Once when camping in spring among scattered snowbanks on the coast of Bering Sea, I had an excellent opportunity to witness their almost incredible quickness. Early in the morning one suddenly appeared on the margin of a snowbank within a few feet, and after craning its neck one way and the other, as though to get a better view of me, it vanished, and then appeared so abruptly on a snowbank three or four yards away that it was almost impossible to follow it with the eye. It was beginning to take on its summer coat of brown and was extremely difficult to locate amid the scattered patches of snow and bare moss of the tundra. Certainly no other mammal can have such flash-like powers of movement.

They feed mainly on mice, lemmings, shrews, small birds, their eggs and young, and insects. Mice furnish a large proportion of their prey and weasels have often been seen following the runways of field mice. Their small size enables them to pursue mice into their underground workings as readily as a ferret enters a rabbit burrow. They also climb trees and bushes with great agility, although nearly always seeking their victims on the ground. The mice upon which they prey are often so much larger than the weasels that they cannot be dragged into the dens. The weasels continue in full activity throughout the winter and constantly burrow into the snow in search of their prey. In the snow or in the ground the holes of this animal are about the diameter of one's finger.

In the Old World the small weasels are reported to have several litters in a season, each containing five or six young. At Point Barrow, Alaska, a female captured on June 12 still contained twelve embryos. This indicates that only one litter a year would be born there, and that *Mustela rixosa* is more prolific than its European representative.

In the more southern latitude least weasels live in forests and about farms, sheltering themselves under logs, brush piles, stone walls,

XUM



THE COMMON BROWN RAT

The large series shows the ordinary foraging gait; the smaller one, to the right, shows the travel at low speed. In all, the tail mark is a strong feature (see pages 423 and 429).

and similar cover. They are always restless and filled with curiosity regarding anything of unusual appearance. When one encounters a man it shows no fear, but slyly moving from one shelter to another, now advancing and now retreating, examines the stranger carefully before going on its way. As they devote practically their entire lives to the destruction of field mice, they are valuable friends of the farmer and should have his good will and protection. Unfortunately for these weasels, no discrimination is shown between them and their larger relatives of more injurious habits.

Among the natives of Alaska all weasels are looked upon with great respect on account of their prowess as hunters. I found this feeling peculiarly strong among the Eskimos, whose existence for ages has depended so largely on the products of the chase. Among them the capture of a weasel meant good luck to the hunter, and to take the rarer least weasel was considered a happy omen. The head and entire skin of the least weasel was highly prized for wearing as an amulet or fetich. Young men eagerly purchased them, paying the full value of a prime marten skin in order to wear them as a personal adornment, that they might thus become endowed with the hunting prowess of this fierce little carnivore. Fathers often bought them to attach to the belts of their small sons, so that the youthful hunters might become imbued with the spirit of this "little chief" among mammals.

THE AMERICAN MINK (Mustela vison and its relatives)

(*For illustration, see page 453*)

In the American mink we have one of the most widely known and valuable fur-bearers of the weasel family. It is a long-bodied animal, but more heavily proportioned than the weasel, and attains a weight of from one and one-half to more than two pounds. It has short legs and walks slowly and rather clumsily with the back arched. When desiring to travel rapidly it moves in a series of rapid easy bounds which it appears able to continue tirelessly.

The minks form a small group of species circumpolar in distribution, and well known in Europe, northern Asia, and in North America. The European animal is closely similar to the North American species and all have the same amphibious habits. The American minks include several different geographic races, which are distributed over all the northern part of the continent from the Atlantic to the Pacific and from the mouths of the Yukon and Mackenzie Rivers to the Gulf coast in the United States. They are absent from the arid Southwestern States.

Few species are more perfectly adapted to a double mode of life than the mink. It is equally at home slyly searching thickets and bottomland forests for prey or seeking it with otter-like prowess beneath the water. It is a restless animal, active both by day and by night, although mainly nocturnal.

While usually having definite dens to which they return, minks wander widely and for so

small an animal hunt over a large territory and pass from one body of water to another. Their wanderings are most pronounced in fall and again during the mating in spring. They are solitary, their companionship with one another not outliving the mating period.

Mink dens are located wherever a safe and convenient shelter is available, and may be a hole in a bank, made by a muskrat or other animal, a cavity under the roots of a tree, a hollow log, a hollow stump, or other place. The nest is made of grass and leaves lined with feathers, hair, and other soft material. A single litter of from four to twelve small and naked young is born during April or May.

The young remain with the mother throughout the summer, and do not leave her to establish themselves until fall, when they are nearly grown. When captured at an early age they are playful and become attached to the person who cares for them. When caught in a trap they become fiercely aggressive, often uttering squalling shrieks, baring their teeth, and fronting their captor with a truculent air of savage rage. The adults have scent sacs located under the tail like those of a skunk. When angry or much excited they can emit from these an exceedingly acrid and offensive odor, but have no power to eject it forcibly at an enemy.

Minks are bold and courageous in their attitude toward other animals, and attack and kill for food species heavier than themselves, like the varying hare and the muskrat. On land they are persistent hunters, trailing their prey skillfully by scent. They eat mice, rats, chipmunks, squirrels, and birds and birds' eggs of many kinds, including waterfowl, oven-birds, and other ground-frequenting species. About the waterside they vary this diet by capturing fish of many kinds, which they pursue in the water, snakes, frogs, salamanders, insects, crustaceans, and mussels.

Their prowess is shown by their raids on chicken-houses, where they often kill many grown fowls in a night, and sometimes drag birds heavier than themselves long distances to their dens. A remarkable indication of the varied menu of the mink was exhibited in a nest found by Dr. C. H. Merriam, where the owner had gathered the bodies of a muskrat, a red squirrel, and a downy woodpecker.

The value of the mink's furry coat has led to its steady pursuit by trappers in all climes, from the coast of Florida to the borders of sluggish streams on Arctic tundras. Millions of them have fallen victims to this warfare and their skins have gone to adorn mankind. In spite of this the mink today occupies all its original territory, and each year yields a fresh harvest of furs.

The mink by preference is a forest animal, living along the wooded bottom-lands of rivers or the thicket-grown borders of small streams, where the rich vegetation gives abundance of shelter and at the same time attracts a wealth of small mammals and birds on which it may prey. From these secure coverts it wanders through the surrounding country at night, visiting many chicken-houses on farms and leaving devastation behind. It is persistent and bold in such forays and in locations near its haunts great care must be exercised to guard against it. Minks have repeatedly raided the enclosures of the National Zoological Park in Washington.

Now and then, on the banks of some wild stream, one will try to appropriate the catch lying at the very feet of a lone fisherman. A naturalist fishing on a stream in northern Canada, seeing a mink making free with his catch, set a small steel trap on the bare ground, and holding the attached chain in one hand raised and slowly drew toward him the fish upon which the mink was feeding. The mink, without hesitation, followed the fish and was caught in the trap.

An abundance of food may modify the preference of the mink for wooded or partly wooded country. The marshy and treeless tundra lying near sea-level in the triangle between the coast of Bering Sea, and the lower parts of the Yukon and Kuskokwim rivers offers such an attractive situation differing from their usual haunts. The sluggish streams and numberless ponds abound with small fish four to five inches long. Minks swarm in this area to such an extent that the Eskimos who inhabit the district are known among the natives of the surrounding region as the "mink people." Steel traps are used there, but a primitive method is even more successful. A wicker fence is built across a narrow stream and a small fyke fish-trap placed in it. In swimming along the stream minks pass into the trap like fish, and I knew of from 10 to 15 being thus taken in one day.

During my residence in that region from 10,000 to 15,000 mink skins were caught in this tundra district annually, and the supply appeared to be inexhaustible. With the growing occupation of the continent and the increasing demand for furs, however, the numbers of the mink must surely decrease. To forestall the shortage of furs that seems imminent, efforts are now being made to establish fur farming to replace the declining supply of wild furs with those grown under domestication. The mink appears to be well adapted to successful breeding in captivity. The main question to solve is the relation of the cost of caring for the animals to the value of its pelt in the market.

THE MARTEN, OR AMERICAN SABLE
(Martes americana and its relatives)

(For illustration, see page 453)

Wild animals possess an endless variety of mental traits which endow them in many instances with marked individualities. Few are more strongly characterized in this respect than the marten. One of the most graceful and beautiful of our forest animals, it frequents the more inaccessible parts of the wilderness and retires shyly before the inroads of the settler's ax. Its rich brown coat, so highly prized that

the pursuit of it goes on winter after winter in all the remote forests of the North, is a source of danger threatening the existence of the species. The full-grown animal weighs five or six pounds and measures nearly three feet in length.

The martens are circumpolar in distribution, and the several species occupy northern lands from England, Europe, and northern Asia to North America. Of the Old World species, the Siberian sable is best known on account of the beauty of its fine, rich fur, which renders it the most valued of all in the fur markets of the world.

The North American marten is a close relative of the Siberian species, and occupies all the wooded parts of North America from the northern limit of trees southward in the forested mountains to Pennsylvania, New Mexico, and the southern part of the Sierra Nevada in California.

Like other members of the weasel tribe, the marten is a fierce and merciless creature of rapine, but unlike the mink and weasel, it avoids the abodes of man and loves the remotest depths of the wilderness.

Martens are endowed with an exceedingly nervous and excitable temperament, combined with all the flashing quickness of weasels. They are more restless than any other among the larger species of their notably restless tribe, and couple with this extraordinary and tireless vigor. This is admirably shown in captivity, when by the hour they dart back and forth, up and down and around their cages with almost incredible speed.

In the forest they climb trees and jump from branch to branch with all the agility of a squirrel—in fact, they pursue and capture red squirrels in fair chase, and have been seen in pursuit of the big California gray squirrel (*Sciurus griseus*). On the ground they move about quickly, hunting weasel-like, under brush piles and other cover.

Practically every living thing within their power falls victim to their rapacity. They eat minks, weasels, squirrels, chipmunks, wood rats, mice of many kinds, conies, snowshoe hares, ruffed and spruce grouse, and smaller birds of all kinds and their eggs, as well as frogs, fish, beetles, crickets, beechnuts, and a variety of small wild fruits. Unlike minks and weasels, they are not known to kill wantonly more than they need for food.

They make nests of grass, moss, and leaves in hollow trees, under logs, among rocks, and in holes in the ground. Sometimes they have been found in possession of a red squirrel's nest, probably after having slain and devoured the owner.

The young, varying from one to eight in number, are born in April or May. At first they are naked and helpless, but when large enough accompany the mother on her search for food. This period of schooling lasts until they are forced to take up their separate lives with the approach of winter. Thenceforth they are among the most solitary of animals, showing fierce antagonism toward one another whenever they meet, and associating only during a brief period in the mating season in February or March. Martens show a cold-blooded ferocity toward one another that often renders it dangerous to put two or more in the same cage. When placed in a cage together the male very commonly kills the female by biting her through the skull. At times they utter a loud, shrill squall or shriek, and in traps hiss, growl, and sometimes bark.

Among the dense forests of spruce and lodgepole pine high up in the mountains of Colorado, martens are sometimes hunted on skis in midwinter, an exciting and often, on these rugged slopes, a dangerous sport. They are not wary about traps and are readily caught by deadfalls and other rude contrivances as well as by steel traps. In Colorado and Montana hundreds of their skins are taken by trappers every winter.

In Siberia the sable has been exterminated by hunting in many districts, and before the present war began had become so scarce in others that the Russian Government closed the season for them for a period of years over nearly all of their range. The same reduction in the numbers of our marten has occurred in most parts of Alaska and elsewhere in its range, and its only hope against extermination lies in stringent protection. Protective regulations are already in force in Alaska.

During the early fur-trading days in northern Canada the number of martens varied between comparative abundance and rarity. These variations were said to occur about every ten years. Some claimed the decrease was due to a migration which the martens were believed to make from one region to another, just as was believed of the lynx. The lack of a corresponding increase in surrounding districts, where trading posts were located, effectually disproved the migration theory. There is little doubt that the increase of martens was due to a reproductive response to a plentiful food supply during years when mice or snowshoe hares were abundant and their decrease was due to a lessening of the numbers of these food animals.

Efforts are being made to domesticate martens and raise them for their skins on fur farms. The main difficulty so far encountered lies in the fiendish manner in which the old males kill the females and the younger males. Although always nervous, they are not difficult to tame, and will be most entertaining and attractive animals to rear if their savage natures can be sufficiently overcome.

THE LITTLE SPOTTED SKUNK
(Spilogale putorius and its relatives)

(*For illustration, see page 456*)

The skunks form a distinct section of the weasel family, limited to North and South America. The group is divided into three well-marked sections. One of these, the little spot-

ted skunks, is distinguished from all other mammals by the curious and pleasing symmetry of the black and white markings of the animals. Few more beautiful fur garments are made than those from the skins of these animals in their natural colors. These skunks are smaller than any members of the other groups, varying from a little larger than a large chipmunk to the size of a fox squirrel.

Little spotted skunks include several species and geographic races. All are limited to North America and are rather irregularly distributed from the Atlantic coast to the Pacific and from Virginia, Minnesota, Wyoming, and southern British Columbia southward to the Gulf coast, to the end of Lower California, and through Mexico and Central America to Costa Rica. They inhabit a variety of climatic conditions, from the rocky ledges high up on the slopes of the western mountains to the hot desert plains of the Southwest, and to partly forested regions in both temperate and tropical lands. In different parts of the United States they have several other names, including "civet," "civet cat," and "hydrophobia skunk."

The spotted skunks make their homes in whatever shelter is most convenient, whether it be clefts in rocky ledges, slide rock, hollows in logs or stumps, holes dug by themselves in banks or under the shelter of cactuses or other thorny vegetation, the deserted holes of burrowing owls in Florida, or the old dens of various kinds of mammals elsewhere. Thickets, open woods, ocean beaches, and the vicinity of deserted or even occupied buildings on ranches are equally welcome haunts. On the plains of Arizona they have been known to live inside the mummified carcass of a cow, the sun-dried hide of which made an impregnable cover. They have a single litter of from two to six young each year.

Their diet is fully as varied as that of others of the weasel kind, but is made up mainly of insects and other forms injurious to agriculture, including grasshoppers, crickets, beetles, and larvæ of many kinds. They feed also on flesh whenever possible and prey on wood rats, mice of many kinds, small ground squirrels, small birds and their eggs, young chickens, lizards, salamanders, and crawfish. This carnivorous diet is further varied with mushrooms, peanuts, persimmons, cactus fruit, and other small fruits. Sometimes the animals locate about occupied habitations in primitive communities, where they give good service by killing the house rats, mice, and cockroaches on the premises. On one occasion a spotted skunk was detected cunningly removing the downy chicks from under a brooding hen without disturbing her.

In comparison with the other skunks these little animals are extremely agile. They are strictly nocturnal and when pursued at night by dogs will climb to safety in a tree like a squirrel. When caught in a trap they struggle and fight far more vigorously than their big relatives. They usually carry the tail in a somewhat elevated position, but when danger threatens hold it upright like a warning signal. If the enemy fails to take heed they shoot two little spraylike jets of liquid bearing the usual offensive skunk odor, and the victim retires without honor.

In writing of these skunks about the Valley

THE COMMON WOODCHUCK, OR AMERICAN MARMOT (SEE PAGES 431-432)

Its track shows this animal's kindship with the squirrels. The small series, to the left, show the ordinary ambling pace. When speeding, it sets its feet much like the little, or eastern, chipmunk (see page 477).

of Mexico, in 1628, Dr. Hernandez tells us that "the powerful arm which they use when in peril is the insupportable gas they throw out behind which condenses the surrounding atmosphere so that, as one grave missionary says, it appears as though one could feel it."

That the little spotted skunk is subject to rabies and has communicated it to many men in the West is unquestionable. It usually bites men who are sleeping on the ground in its haunts, as they commonly do on the western stock ranges.

I have personally known of several instances in northern Arizona of men being bitten by them. The head, face, and hands, being uncovered, are the points attacked. One man in the mountains south of Winslow, Arizona, was bitten on the top of his head in April, 1910, but paid no attention to the slight wound until two months later when he began to have spasms. He then hurried to town and died in great agony the next day. The year following a man in the same district was bitten in the face, and seizing the animal threw it from him in such a manner that it fell on his brother and bit him before he wakened. Both men were given the Pasteur treatment and had no further trouble.

On New Year's night of 1906, while I was at the village of Cape San Lucas, at the extreme southern end of the Peninsula of Lower California, a large-sized old male spotted skunk entered the open door of a neighboring house and bit through the upper lip of a little girl sleeping on the floor. Her screams brought her father to the rescue, and with a well-aimed blow he killed the offender. The next morning the skunk was brought to me and added to my collection. As I left a few days later I never learned the result of this bite, but while there was informed that a man had died the previous year from a similar bite. The occasional instances of this kind are remembered and appear more numerous than they are in fact. For years many men have slept in the open where these animals abound, without being molested. It is interesting to find that when the voyager Duhaut-Cilly visited the Cape in 1826, the natives feared these skunks because they entered houses at night, biting people and infecting them with hydrophobia.

The little spotted skunks have extremely animated, playful natures, as I have had several occasions to observe. Two instances serve to illustrate this. Once at the mouth of a canyon at the southern end of the San Joaquin Valley, California, I camped several days at a deserted ranch. At night I spread my blankets on the bare floor of the house, from which the doors were gone. Under it led several burrows of some animal which I at first supposed to be a ground squirrel. Each night while there I was awakened by the sound of little footfalls padding rapidly about over the floor on which I was sleeping, and in the dim light from the moon could see two or three little spotted skunks pursuing one another around me like playful kittens. At the slightest movement on my part they dashed out the door and into their dens under the house. As there was no food of any kind in this room, it was evident that the little fellows were there for a frolic on the smooth board floor.

On another occasion in the mountains of San Luis Potosi, on the Mexican table-land, I found a spring to which bears were coming for water at night. As the bears here appeared to be strictly nocturnal, I ensconced myself in the evening with a dark lantern, amid some small bushes, against a large pine log which sloped downward to the bottom of the gulch near the spring, with the plan to welcome any bears which might come in. An hour or more after dark the clinking rattle of small stones on the far side of the gulch indicated the presence of some animal. The light from the lantern was flashed on the spot and the rifle lowered with exasperation as, running back and forth, turning over stones in search of insects, a spotted skunk was revealed. The movements of this unwelcome visitor were extremely light and graceful, and in my interest in watching them, for a time I forgot the bear. Two or three hours passed and the skunk tired of the hillside and came down to the spring, where he found the offal from a deer which I had placed there for bait. This gave him more to do, and after I had listened to him worry the meat for awhile, I turned on the light and was entertained by the sight thus revealed. The skunk appeared to have a persistent desire to drag away the offal many times his weight. He would seize the edge of one of the lungs and after a hard struggle would get it up on one edge, when the burden would turn over with a flap, whirling the skunk flat on his back each time. Immediately scrambling to his feet, he would give the meat a fierce shake of resentment and repeat the performance.

After a long time the moon arose and the skunk could be plainly seen running back and forth playfully, now biting at the meat and now turning over stones apparently in sheer exuberance of spirit. Then he suddenly mounted the lower end of the log and came galloping up it until he was close to my shoulder. There he stopped and, coming as near as possible, extended his nose within a few inches of my face, and for minute or more stood trying to satisfy himself about this strange object. Satisfied at last, he turned and galloped back down the log and resumed his antics in the gulch, finally working close to the bank three or four yards below me. There he found many small stones and had a fine time rattling them about until I decided that with this disturbing presence I should have little chance for other game. Finding a convenient stone, and locating the skunk as well as possible from the sounds, I tossed it over to try and frighten him away. My aim was too true, for the characteristic skunk retort filled the air with suffocating fumes and I immediately lost interest in further bear hunting.

XUM

THE COMMON SKUNK (Mephitis mephitis and its relatives)

(*For illustration, see page 456*)

Probably no American mammal is more generally known and less popular than the skunk. This current odium is due wholly to its possession of a scent sac of malodorous fluid, which it distributes with prompt accuracy when annoyed. The possession of this method of defense is common to all skunks. The term "pole-cat," sometimes given to all kinds of skunks, is the misuse of a name given Old World martens of several species and to the Cape pole-cat, a South African animal which in form and markings, including the plumelike tail, is remarkably like some of our smaller skunks.

In the preceding article an account was given of the spotted skunks, smallest of the three groups into which these animals are divided. The common skunk and its relatives form another group, which contains some of the larger species of their kind, some of them weighing up to ten pounds or more. These are the typical skunks, so familiar in most parts of the United States, and distinguished by the disproportionately large size of the posterior half of the body and the long, plumelike tail.

The common skunk, with its closely related species, is generally distributed in all varieties of country, except in deep forests and on waterless desert plains. It ranges from the Atlantic coast to the Pacific and from Hudson Bay and Great Slave Lake southward to the highlands of Guatemala. The vertical range extends from sea-level up to above timberline in Mexico, where I found one living in a burrow it had dug under a rock at 13,800 feet altitude on the Cofre de Perote, Vera Cruz.

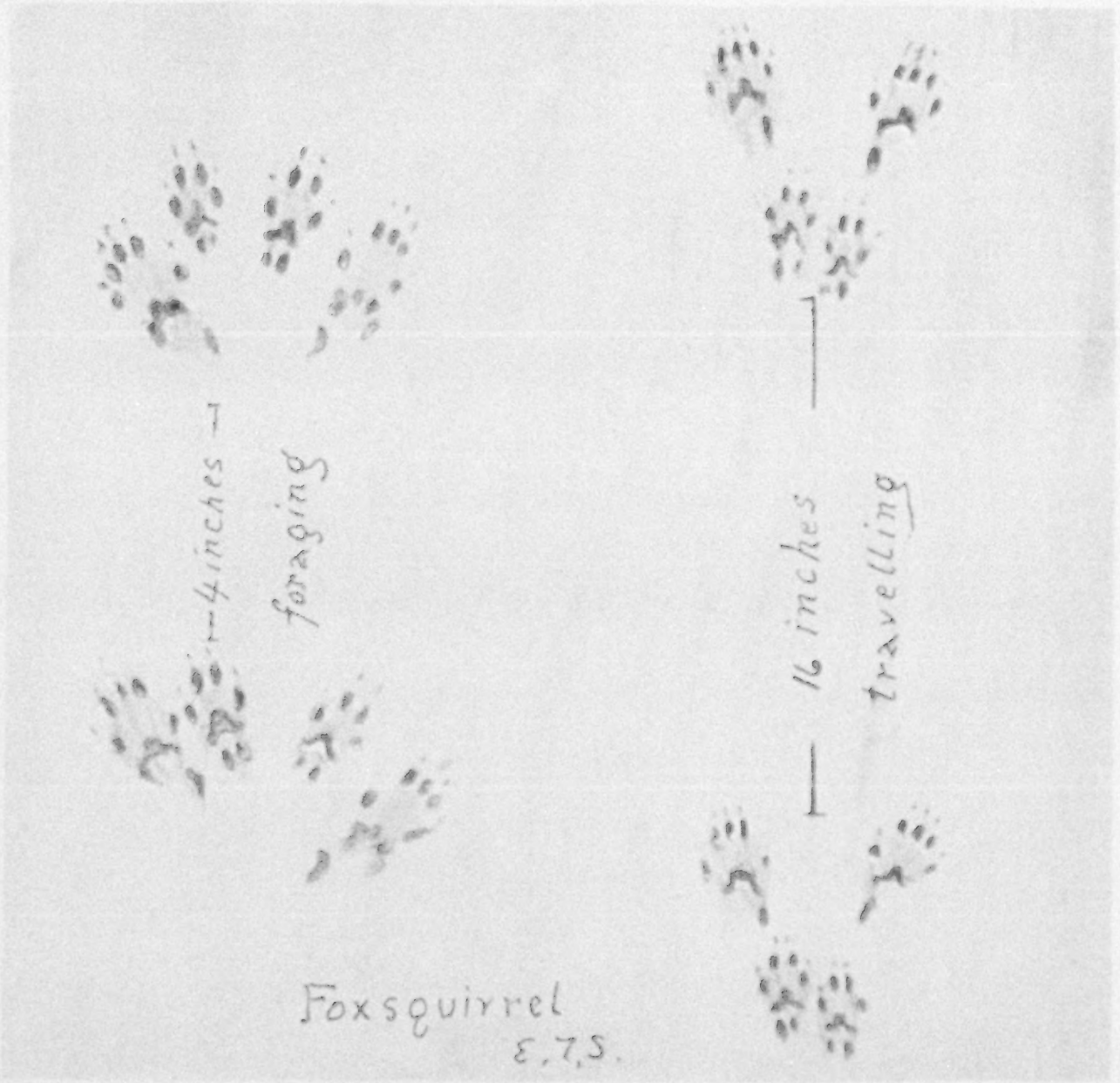
Skunks are most common in areas of mixed woodland and fields, in valley bottoms, and along the brushy borders of creeks and rocky canyons. One of their marked characteristics is a fondness for the vicinity of man. They frequently visit his premises, taking up quarters beneath outbuildings or even under the house itself.

Any convenient shelter appears to satisfy them for a home, and they will occupy the deserted burrows of other animals, small cavities among the rocks, a hollow log, or a hole dug by themselves. A warm nest of grass and leaves is made at the end of the den, where the single litter of young, containing from four to ten, is born in April or May. As soon as the young are old enough they follow the mother, keeping close behind her, often in a long single file along a trail. They are mainly nocturnal, but in summer the mother frequently starts out on an excursion with her young an hour or two before sunset and they may remain abroad all night.

The young family remains united through the following winter, which accounts for finding at times from eight to a dozen in a den. In all the northern parts of their range they hibernate during the two to four months of severest cold weather, coming out sometimes during mild periods. When the season of hibernation ends the family scatters and mating begins. One solitary skunk was found in Canada hibernating

THE TRAIL OF THE EASTERN CHIPMUNK

The track is much like that of the fox squirrel, but usually the fore feet are a little, or quite, one behind the other and, of course, much smaller. No tail mark is ever seen (see pages 440 and 447).



THE TRACKS OF A RUSTY FOX SQUIRREL AND FOX SQUIRREL

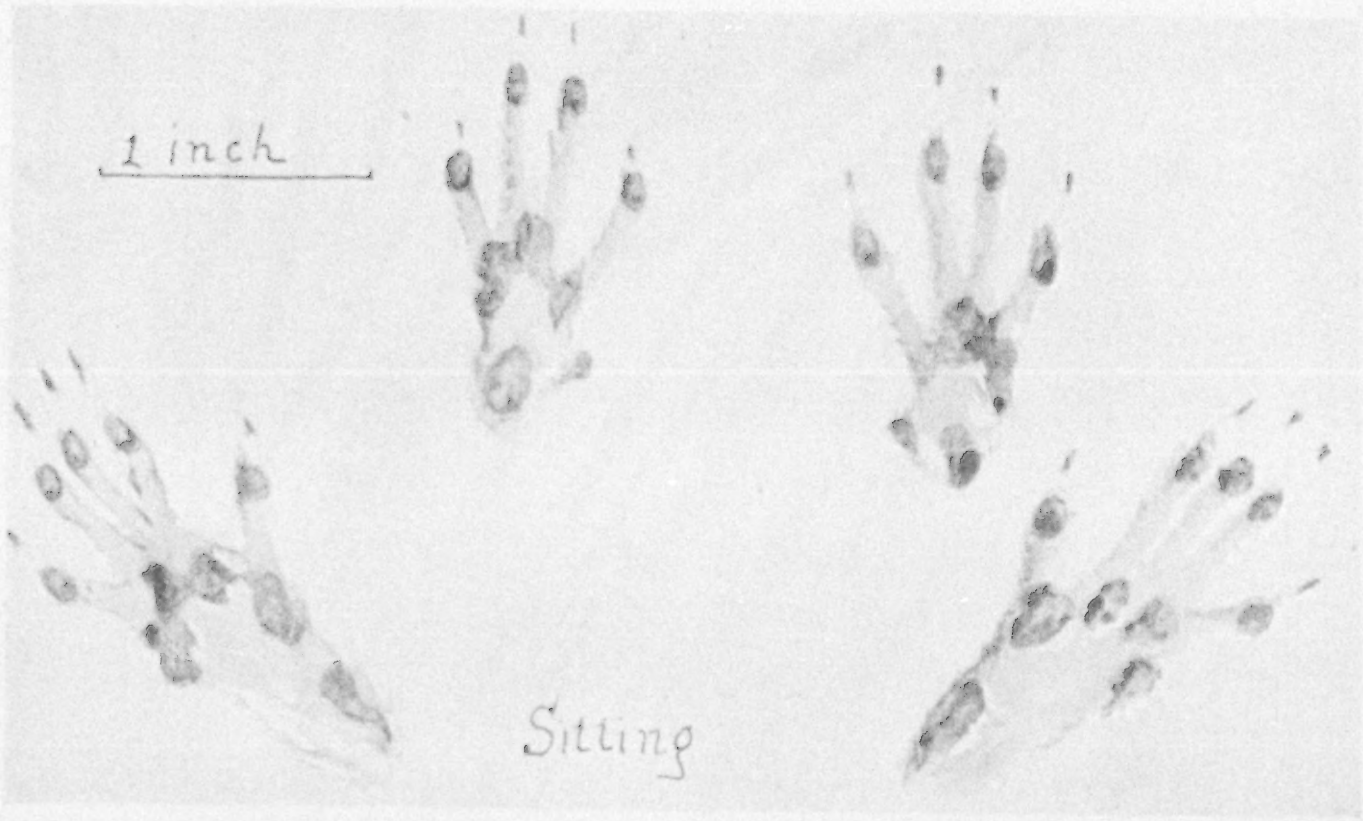
The exaggerated pads of the squirrel foot are a strong feature of this track. It is typical in the pairing of the fore feet, much more so than that of the gray squirrel. There is never a tail mark in this track (see pages 445 and 459).

in the same burrow, but in a separate chamber, with a woodchuck, evidently an unbidden guest.

As in the case of their relatives, the common skunks are omnivorous, but feed mainly upon insects and rodents injurious to agriculture. They are known to eat great quantities of grasshoppers, besides crickets, cicadas, May beetles, wasps, and larvæ of many kinds. One killed in New Mexico had its stomach crammed with honey bees. Wherever possible they prey upon small rodents, as mice, wood rats, and small spermophiles. To these may be added ground-nesting birds and their eggs, lizards, turtle eggs, snakes, frogs, salamanders, fish, crustaceans, and numerous small fruits. Now and then they visit the farmers' chicken yards with such disastrous consequences that in many country districts the animals are killed at sight.

It is pleasing to record that a more intelligent view of their real value to farmers, through their destruction of farm pests, is rapidly gaining ground, and they are now being protected in many States. One of their worst traits is their destructiveness to breeding game birds, both upland species, and especially the waterfowl.

Skunks walk on the soles of their feet instead of on their toes, as do so many mammals. The common skunks are wholly terrestrial and move with the deliberation of one without fear of personal violence or of having his dignity assailed. Long experience has taught them that the right of way is theirs. As they amble slowly along, the tail is carried slightly elevated, and when the owner is suspicious of attack, it is raised and the hairs hang drooping like a great plume, conspicuous and unmistakable. If the disturber still refuses to take the hint, a



A FULL SIZE RENDERING OF A FOX SQUIRREL TRACK

Illustrations of the arrangement of this track when the animal is foraging and traveling are shown on the opposite page

rear view is promptly presented and a discharge made that puts most enemies to flight. Some have thought that the odorous liquid is scattered by the long hairs of the tail, but in fact it is ejected in fine jets from two little tubes connected with the scent sacs on each side of the vent.

When mildly annoyed the big skunks stamp their front feet on the ground and utter little growls of displeasure. By some effort they can be urged into a retreat which may take the form of a clumsy gallop. They are known occasionally to swim streams voluntarily, and even to cross rivers, probably urged by the instinct that so often forces animals of all kinds to move to new feeding grounds.

Although usually safe from annoyance through the protective armament, many skunks, especially the young, each year fall victim to natural enemies, including wolves, coyotes, foxes, badgers, and great horned owls.

The flesh of the skunk is a favorite food among certain tribes of Canadian Indians, and many white men have pronounced it exceedingly palatable, even claiming its superiority over the flesh of domestic fowls. In the narrative of his expedition through the Canadian wilderness many years ago, the naturalist Drummond recorded that when the party was about a day's journey from Carleton House it had the good fortune to kill a skunk, "which afforded us a comfortable meal." In the Valley of Mexico I found the natives prize the flesh of these animals as a cure for a certain loathsome disease.

It is well known that large skunks are often extremely fat. The oil produced from them is clear and is said to have unusually penetrating qualities. For many years there was a demand for this oil for various medicinal purposes.

During recent years the fur of skunks has come into great demand, and good prices are paid for prime skins. The animals are so numerous and the catch is so large that they now rank among the most valuable of our fur-bearers. They are gentle animals which readily become domesticated and breed freely in confinement, and many efforts are being made to establish skunk farms. Success in such farming depends wholly on the outlay for upkeep. Skunk farming will probably pay better as a side line, like chickens on the ordinary farm, than to establish regular fur farms. The scent sac may be removed by a slight surgical operation, so there need be no trouble from that source. Common skunks when taken young make affectionate and entertaining pets. They become as tame and playful as kittens, and are vastly more intelligent and interesting.

THE HOG-NOSED SKUNK (Conepatus mesoleucus and its relatives)

(*For illustration, see page 457*)

The third and last group of skunks contains a number of species showing well-marked differences from the two groups already described. The species vary in size, but among them is included the largest of all skunks. All are characterized by comparatively short hair, es-

pecially on the tail, and this appendage lacks the plumelike appearance observed in other skunks. The nose is prolonged into a distinct "snout," naked on the top and sides and evidently used for rooting in the earth after the manner of a pig. In addition, the front feet are armed with long, heavy claws, and the front legs and shoulders are provided with a strong muscular development for digging, as in a badger. This likeness has led to the use in some places of the appropriate name "badger skunk" for these animals. The single white stripe along the back, and including the tail, is a common pattern with these skunks, but this marking is considerably varied, as in the common species.

The hog-nosed skunks are the only representatives of the skunk tribe in South America, where various species occupy a large part of the continent. They appear to form a South American group of mammals which has extended its range northward through Central America, Mexico, and across the border of the United States to central Texas, New Mexico, and Arizona. In Mexico they range from sea-level to above 10,000 feet altitude on the mountains of the interior.

The hair on these skunks is coarse and harsh, lacking the qualities which render the coats of their northern relatives so valuable. Where their range coincides with that of the common skunks, the local distribution of the two is practically the same. They live along the bottom-lands of watercourses, where vegetation is abundant and the supply of food most plentiful, or in canyons and on rocky mountain slopes.

For shelter they dig their own burrows, usually in a bank, or under a rock, or the roots of a tree, but do not hesitate to take possession of the deserted burrows of other animals, or of natural cavities among the rocks. Owing to their strictly nocturnal habits, they are much less frequently seen than the common skunks, even in localities where they are numerous. In fact it is only within the last few years that their presence in many parts of the southwestern border has become known.

Although both the little spotted and common skunks live mainly on insects, the hog-nosed skunks are even more insectivorous in their feeding habits. The bare snout appears to be used constantly for the purpose of rooting out beetles, grubs, and larvæ of various kinds from the ground.

On the highlands of Mexico I have many times camped in localities where patches of ground were rooted up nightly by these skunks to a depth of two or three inches as thoroughly as might have been done by small pigs. In such places I repeatedly failed to capture them by traps baited with meat, the insects and grubs they were finding apparently being more attractive food. I have had similar failures in trapping for coyotes with meat bait in localities where they were feeding fat on swarms of large beetles and crickets. The persistence with which the hog-nosed skunks hunt insects renders them a valuable aid to farmers.

In addition to grasshoppers, crickets, beetles, flies, grubs, and other larvæ, and many other insects, they are known to eat wood rats, mice, and the small fruit of cactuses and other plants. The stomach of one of these skunks examined in Texas contained about 400 beetles.

One Texas naturalist writes that he has lost a number of young kids which had their noses bitten off, and in one instance caught one of these skunks mutilating a kid in this manner. He also states that they pull down and eat corn when it is in the "roasting-ear" stage.

Far less is known concerning the habits of hog-nosed skunks than of the other species of these animals. The number of young appears to be small, judging from the record of a single embryo found in one animal and in another instance of two young found in a nest located in a hollow stump. They have a curiously stupid, sluggish manner and have even less vivacity than the somewhat sedate common skunk. No use is made of their skins in this country or in Mexico, but the gigantic natives of Patagonia make robes of them which are worn like great cloaks.

THE NINE-BANDED ARMADILLO
(Dasypus novemcincta and its relatives)

(*For illustration, see page 457*)

Armadillos are distinguished from other mammals by having the nearly, or quite, hairless skin developed into a bony armor covering the upperparts of the head and body and all of the tail. They lack teeth in the front of both upper and lower jaws, and are members of the group of toothless animals which includes the ant-eaters. The insects they feed on are licked up by the sticky surface of their extensile tongues.

In the remote past many species of armadillos, some of gigantic size, roamed the plains of South America, and a number of small species still exist there. These animals are peculiar to America and have their center of abundance in the southern continent.

The nine-banded species ranges over an enormous territory and is subdivided into a number of geographic races, living from southern Texas through Mexico and Central America to Argentina. In Mexico its vertical distribution extends from sea-level up to an altitude of about 10,000 feet on the mountains of the interior. Like the hog-nosed skunk, it no doubt originated as a member of the South American fauna and has spread northward to its present limits. It is one of the larger of the living representatives of this curious group of animals and reaches a weight of from twelve to fifteen pounds.

As might be surmised from its appearance, the armadillo is a stupid animal, living a monotonous life of restricted activities. Its sight and hearing are poor, and the armored skin gives it a stiff-legged gait and immobile body. From these characteristics, combined with the small head hung low on a short neck, it has in life an odd resemblance in both form and

XUM

motion to a small pig; it jogs along in its trails or from one feeding place to another with the same little stiff trotting gait and self-centered air. If alarmed it will break into a clumsy gallop, but moves so slowly that it may be overtaken by a man on foot. So poor is its eyesight that a person may approach openly within about thirty yards before being noticed.

When alarmed the armadillo immediately runs to the shelter of its burrow, but may easily be caught in one's hands, especially if intercepted on the way to its den. When caught it will struggle to escape, and while it may coil up in a ball in the presence of a dog or other mammal foe, I never saw one try to protect itself in this way. While presumably serving for protective purposes, the armor is flexible on the sides of the body, and I have found the remains of many armadillos where they had been killed and eaten by coyotes or other predatory beasts. The armor would no doubt be sufficient protection to enable them to escape to cover from the attack of birds of prey. They are mainly nocturnal animals, but are frequently seen abroad by day and in some places appear to be out equally by day or night.

This armadillo lives by preference amid the cover afforded by forests, brushy jungle, tall grass, or other vegetation. In the midst of such shelter it usually digs its own burrow a few yards deep in a bank or hill slope, beneath a stump, under the roots of a tree, or a rock, or even on level ground. It will also occupy small caves in limestone rock. At times it shows a piglike fondness for a mud bath, and the prints of its armor may be found where it has wallowed in miry spots.

Well-beaten and conspicuous trails lead from the burrows often for half a mile or more, frequently branching through the thickets in various directions. Armadillo burrows sometimes accommodate strange neighbors, as was shown by one in Texas which was dug out, and in addition to containing the owner in his den at the end, was found to be occupied by a four-foot rattlesnake and a half-grown cottontail rabbit, each in a side chamber of its own.

The food of the armadillo consists almost entirely of many species of insects, among which ants appear to predominate. When searching for food the animals become so intent that they may be cautiously approached and closely observed or captured by hand. They root about among fallen leaves and other loose vegetation and soft earth, now and then digging up some hidden grub or beetle. At night they visit newly plowed fields in their haunts, rooting in the mellow earth. They are accused of digging up plants in gardens during their nocturnal wanderings, and in Texas have been charged with robbing hens' nests of eggs, and of reducing the supply of wild turkeys and quail by breaking up the nests, all of which needs confirmation. Their method of feeding appears to vary considerably, as they have been seen rising on their hind legs to secure small caterpillars infesting large weeds.

The insect food eaten by the nine-banded armadillo in Texas, as known from examina-

THE TRACK OF THE WEASEL

The unusual space between the fore and hind feet in the middle of the left series is often seen. Sometimes the tail mark is there and sometimes not. Sometimes the trail is like that of a small mink. The toes seldom show (see pages 452 and 469).

AMERICAN MINK TRACKS, SHOWING VARIOUS ARRANGEMENTS AND TAIL MARKS

The typical track of a mink is as in the bottom set at the left, which also illustrates the tail mark. Twelve to twenty-four inches are usually cleared at each bound. This illustration is greatly reduced from natural size (see opposite page and pages 453 and 472).

tion of stomach contents, covers a wide range of insect and other small life, including many species of grasshoppers, crickets, roaches, caterpillars, beetles, ants, spiders, centipedes, and earthworms. As the list includes also wireworms and other noxious species, these inoffensive animals deserve thorough protection as a most useful aid to the farmer.

Some time from February to April each year, litters of from four to eight young are born. They have their eyes open at birth, and the armor is soft and flexible like fine leather. The hardening of the skin into a bony armor is progressive, continuing until after the animal fully completes its growth. As soon as the young are able to travel they trot along with the old one during her foraging trips.

Early one afternoon, when riding along a trail in the heavy forest of southern Oaxaca, accompanied by an Indian boy and a pack of dogs, I suddenly came upon an old armadillo and eight young about two-thirds grown. They had heard our approach and stood motionless in a compact little group half hidden in the grass. I had barely time to stop my horse when the dogs spied them and made a rush. The armadillos darted into the undergrowth in every direction like a litter of pigs, and with the exception of two caught by the dogs gained safe refuge in their burrow. This we found dug in the level ground about fifty yards from where we encountered them.

The Maya Indians of the peninsula of Yucatan have a legend that the black-headed vulture (*Catharista atrata*) in old age changes into an armadillo. The tale runs, that when a vulture becomes very, very old it notifies its companions that the time has come and alights before a hole in the ground that resembles the den of an armadillo. The other vultures bring food and the old one remains there for a long time. Its wings disappear, the feathers are lost, and when the change is complete the newly created armadillo enters the hole and begins its new life. If skepticism is expressed as to this metamorphosis, the Indians point out as proof of the legend the similarity between the appearance of the bald pate of the vulture and that of the armadillo.

THE RING-TAILED CAT (Bassariscus astutus and its relatives)

(*For illustration, see page 460*)

The mild climate and the proximity of the Southwestern States to Mexico and the tropics brings within our borders numerous strange types of wild life. Of these the ring-tailed cat is one of the most strikingly marked and interesting. In the United States it is known by several other names, including "civet cat," "coon cat," and "band-tailed cat." In Mexico it still bears the old Aztec name cacomixtle, except in Lower California, where it is the

"babisuri." It is about the size of a large cat, but with proportionately longer and slenderer body, shorter legs, and longer tail. The alternating bands of black and white on the tail proclaim its relationship, not to the cat, to which it has no kinship, but to the raccoon, which has a tail similarly marked. Few mammals possess such a beautifully formed head and face, and its large, mild eyes give it a vivid expression of intelligence.

The ring-tailed cat occupies areas under such differing climates as to produce geographic races, but none of them vary strikingly from the typical animal here illustrated. They range from Oregon, Nevada, southern Utah, Colorado, and Texas south to Costa Rica. In Mexico they occur from near sea-level up to an altitude of about 10,000 feet. While chiefly rock-inhabiting species, they sometimes live in the forest and as a rule make their dens in caves and deep crevices, but sometimes in hollow trees or about houses. Their young, from three to four in number, are born in May or June.

AMERICAN MINK TRACK NEARLY NATURAL SIZE

Although this animal has five toes on each foot, only four appear in each track. This illustration, which is practically natural size, shows the usual arrangement of the track. The hind feet are, of course, in advance. Variations of arrangement are shown on the opposite page (see also pages 453 and 472).

In the Southwest they frequent some of the ruined cliff dwellings, and I have found them haunting many of the ancient ruins of Mexico. Their presence in little caves and other sheltered spots along cliffs and rock walls bordering canyons or on mountain slopes may usually be known by an examination of the fine dust which accumulates in sheltered places. Whenever present their delicate cat-like tracks will be found where they have been hunting mice or other small game.

Strictly nocturnal, they do not sally forth from their dens until darkness is complete. During the night they are restless and frequently wander far and wide in search of food, and apparently at times merely to satisfy a spirit of inquiry. Their inquisitive nature frequently leads them to explore the streets of towns and cities on the Mexican table-land, filled though these places are with dogs. At daybreak, tracks left in the dusty streets tell the story of their wanderings, as they often do also in the case of opossums.

One morning in February, 1893, soon after sunrise, I chanced to pass through a little wooded square in the City of Mexico and saw a lot of boys pursue and capture one of these animals which, having overstayed its time, had been surprised by daybreak. This wanderer might have had its den in some house in the neighborhood, since one of its known habits is to take up its abode about houses, even in the midst of towns. A friend living in the City of Mexico informed me that after having been annoyed for some time by noises on the roof at night, he investigated and discovered a female cacomixtle with partly grown young

snugly located in a nest placed in a narrow space between the tile roof and the ceiling. In southern Texas the animals live on the brush-grown plains under conditions very different from those usually chosen.

Like its relative the raccoon, the cacomixtle, with a taste for a varied fare, takes whatever edibles come its way. It stalks wood rats, mice, and even bats amid their rocky haunts and birds in bushes and low trees. About the southern end of the Mexican table-land it is much disliked for its robberies of chicken roosts, especially when these are located in trees. Insects of many kinds, larvæ, and centipedes are eaten, as well as a great variety of fruits, including that of the pear-leaved cactus, and dates, figs, and green corn.

Ring-tailed cats regularly locate among rocky ledges, neighboring orchards, or other cultivated areas where they may gather some of the bounty provided by man. I found them more plentiful among the broken lava cliffs bordering date palm orchards in Lower California than in any other place. When the dates were ripening they prowled about under the palms after dark with gray foxes and spotted skunks to pick up the fallen fruit. They sometimes uttered a complaining cry and when caught in a trap would bark almost like a little dog, or occasionally utter a vicious scream of mixed fear and rage.

Being an intelligent animal, the cacomixtle is readily tamed and makes a most interesting pet. During the early years of gold mining in California, when many men were living in rude cabins in the mountains, the prevalence of mice often attracted these "cats" to take up their residence there. Often the owner of the premises and the mouser struck up a friendly relationship and the cacomixtle, becoming as free and friendly about the place as a real cat, kept it entirely clear from mice. I have had first-hand accounts of these tame individuals from miners who had harbored them in this way for months. These accounts always gave the impression that the animal was somewhat playful and mischievous and most attractive to have about the premises. All agreed that it was extremely fond of sugar.

THE OREGON MOLE (Scapanus townsendi and its relatives)

(For illustration, see page 461)

The effect on mammals of a narrowly specialized mode of life is well illustrated in the mole. It is an expertly constructed living mechanism for tunneling through the earth. The pointed nose, short neck, compactly and powerfully built cylindrical body, with ribs strongly braced to withstand pressure, and the short, paddlelike hands armed with strong claws for digging are all fitted for a single purpose. Eyes and ears are of little service in an underground life, so they have become practically obsolete; the fur has been modified to a compact velvety coat which will lie either front or back with equal facility and thus relieve any friction from the walls of the tunneled roads, no matter which way the animal travels.

Moles are circumpolar in distribution, being found from England to Japan in the Old World and on both the Atlantic and Pacific coasts of the New World where they occur only in North America. On this continent they are limited mainly to the United States and southern Canada, extending across the Mexican border only in two limited areas at the extreme east and west. Their distribution is not continuous across the continent, but is broken by a broad unoccupied belt formed by the arid interior, including the Great Basin. The home of the Oregon mole lies in the humid area west of the Cascade Mountains in Washington, Oregon, and extreme northwestern California. Closely related forms range from eastern Oregon southward through California to the San Pedro Martir Mountains in Lower California, and others north into British Columbia.

The Oregon mole is the largest and handsomest member of the group in America and perhaps in the world. Its skin, a velvety coat of nearly black fur, often with a purplish sheen, now brings a higher price in the market than that of any other species. Its size and the beauty of its dark coat distinguish it from any other mole.

Where the soil is loose the mole practically swims through it, urged forward by powerful impulses of its "hands" and feet. This is the common mode of travel near the top of the ground, where the course is marked by the lightly upheaved and broken surface. When working at a greater depth and in more compact soil the mole must dig its way and dispose of the loose earth by pushing it along the tunnel to an outlet at the surface through which it is thrust to form a mound similar to the "dumps" of that other great miner, the pocket gopher.

On account of this similarity in mode of life, moles and pocket gophers are sometimes confused by persons not familiar with the two animals. The resemblance ends in this apparent likeness, for the pocket gophers belong to the great order Rodentia, or gnawing animals, while the moles are of the Insectivora, or insect-eaters.

The superbly forested region inhabited by Oregon moles is so well watered that few places, even on high mountain slopes, are too dry for them to occupy. These animals are generally distributed, and their hills may be seen in the midst of the great coniferous forests as well as in the open valleys.

They are most abundant in open grassy areas, especially in meadows and in the bottoms of canyons and similar places, where the damp rich soil affords a plentiful supply of earthworms, grubs, and insects on which to feed. Like other moles, they lead lives of great activity and almost constant hard labor. During damp weather they work near the surface, but in dry periods as the upper soil hardens they

follow their prey to lower levels. A hard shower, however, always brings an outburst of activity as they reoccupy the upper soil and throw up a multitude of new mounds. They have the habit of regularly coming to the surface to hunt food during the night. This is no doubt coincident with the swarming up to the surface of earthworms on which the moles feed. At such times many are captured by owls, cats, and other beasts of prey.

The runways of moles close along the surface, shown by well-marked ridges, are for hunting purposes, and the lower tunnels, from which the earth in the mounds is brought, are for traveling and lead to the nest chamber. The deep tunnels of the Oregon mole sometimes extend considerable distances along fences, or other surface cover, which afford more or less protection. Such tunnels are a kind of highway often used by several moles and also by shrews and field mice. The system of tunnels of the moles over a considerable area often intersect and are used more or less in common. As a result more than twenty moles have been trapped at a single point in one of these underground roads.

They make an intricate system of many-branched tunnels, the courses of which are usually marked by series of mounds varying from four to ten inches high and five to twenty inches wide and often scattered over meadows or other fields from two to six feet apart. Owing to the persistence with which the moles raise their mounds everywhere in the occupied parts of their territory, they have become a serious and costly pest. In meadows the knives of mowing machines are dulled by them, and in towns lawns are disfigured by their undesirable activities. As a consequence they have now fallen under the ban and are classed with other mammals which have shown their lack of ability to fit in satisfactorily with the changed conditions brought to their ancient territory by civilized man. Under natural conditions their activities were undoubtedly entirely beneficial.

They appear to have but a single litter of young, numbering from one to four, each year. These are born in March and grow so rapidly that by the last of May they are working in the tunnels and are scarcely distinguishable from the adults.

The recent discovery that the Oregon moleskin is valuable for its fur will give such an incentive to trapping that there is little doubt the boys of the State within a few years will reduce the numbers of the animal and thus control its injury to agriculture. The market for the skins appears practically unlimited, judging by trade reports, one dealer in Brooklyn stating that he dressed 4,000,000 imported European moleskins in 1916.

THE STAR-NOSED MOLE (Condylura cristata)

(*For illustration, see page 461*)

The star-nosed mole, known in parts of Maine as the "gopher," is peculiar among the moles in having a fringe around the end of its nose formed by twenty-two short fleshy tentacles. A less-marked character is in the proportionately long tail, which becomes greatly enlarged in fall and remains in this condition during the winter months. Otherwise the external appearance of this species is much like that of the common moles of America and the Old World.

The star-nosed mole is found from southern Labrador, the southern end of Hudson Bay, and southeastern Manitoba south along the Atlantic coast to Georgia and in the interior down the Alleghenies to North Carolina and to Ohio, Indiana, Illinois, Wisconsin, and Minnesota. Throughout this area it ranges irregularly and much yet remains to be learned about the details of its distribution and habits.

Ordinarily solitary, these moles at times are so numerous in limited areas that they appear to form colonies. Such gatherings probably mean an unusually rich feeding ground, which makes it unnecessary for the young to disperse to outlying locations, as is the habit of moles and most other mammals.

The star-nosed mole has a strong preference for damp and even marshy or swampy locations. It frequents low-lying meadows, the borders of streams, and grassy swamps, where its underground burrows alternate with open surface runways among grass roots and other matted vegetation. It spends far more time above ground than the other moles, and not infrequently swims among flooded cat-tails and other vegetation and in winter has been seen swimming under the ice.

Like others of its kind, this mole is amazingly powerful in proportion to its size. It persistently adds to its surface ridges, and in constantly extending its deeper tunnels must dig loose earth and dispose of it by forcing it up through an outlet to form the mounds which mark the course of its travels. Where the soil is loose it readily forces it aside with its compact body and paddle-shaped hands. In pushing up the little piles of earth and in the ridges raised when burrowing close to the surface it sometimes injures meadows and other cultivated land. Occasionally it wanders away from the fields and invades lawns and gardens, where the only injury it does is in the disturbance of the soil.

Its nests are compact little balls of fine grass, weeds, or leaves in dry underground chambers excavated in its burrows. The nests are a foot or two underground, but above the level of the water, sometimes under a stump and again in a knoll or bank. One nest containing five young was found in Maryland in an old woodshed under several inches of chips. This location and its choice of a site for its nest under a stump in a field or in a dry knoll are clear indications of a kind of intelligence which even the lowliest animals appear to have in caring for their young.

The star-nosed mole is full of the restless energy so necessary in a mammal which must come across its food by more or less haphazard tunneling through the soil. It is active both summer and winter. In dry weather as the

moisture near the surface decreases the soil hardens and earthworms and other subterranean life seek deeper levels. The mole follows them, only to return with them nearer the surface with a renewal of the moisture. In winter it sometimes comes out and travels slowly about on top of the snow, ready to burrow out of sight at once, however, at the sound of approaching footsteps.

The food of the star-nose, like that of most other moles, is made up mainly of earthworms, white grubs, cutworms, wireworms, and other underground insects. In captivity, before eating a worm or other flesh food offered, it first feels of it with the little raylike organs of touch on its nose. It is difficult to surmise the real value of these "feelers," for it would seem that the acute sense of smell so common to mammals should do better service.

Aside from its disturbance of the surface soil by its ridges and mounds, the star-nosed mole does no direct injury, and its life is largely passed in the useful task of searching out and destroying insects. Indirectly it causes some injury to root crops, plants of various kinds, and fruit trees, by providing tunnels along which meadow and pine mice travel to commit the ravages which on circumstantial evidence are charged to the mole.

THE COMMON SHREW (Sorex personatus and its relatives)

(For illustration, see page 464)

Many interesting small mammals are nocturnal or lead such obscure and hidden lives that they are rarely observed except by naturalists. Of these are the numerous species of shrews, which include the smallest mammals in the world. These tiny beasts all live among the vegetation and debris on the surface of the ground or in little burrows below. With the moles they are members of the order Insectivora and depend mainly on insects and meat for food. Despite their minute size, they are possessed of an indomitable courage and ferocity, which leads them without hesitation to attack and kill mice many times their own weight.

The genus *Sorex*, of which the common shrew is a member, is circumpolar in distribution, the various species ranging through England, the European mainland, Asia, and North America as far south as Guatemala.

The common shrew is a purely North American animal, occupying all the northern part of the continent from the Arctic shores of Alaska and Canada south to northern Nevada, South Dakota, Illinois, and Pennsylvania, and along the Allegheny and high Rocky Mountains to North Carolina and New Mexico. Its vertical range extends from the seacoast up to timberline in the Rocky Mountains.

The common shrew is the smallest of the mammals in all the northern parts of this continent, and one marvels at the possibility of such a tiny morsel of flesh and blood withstanding the rigors of the arctic winters. It measures about four inches in total length and weighs about forty-five grains; the body and tail are slender, the nose long and sharp, and the rim of the ears shows a little above the dense velvety fur. By these characters it may be distinguished from the larger, more heavily proportioned (and darker-colored) short-tailed shrews which abound with it in certain parts of its range. Its smaller size and grayish brown color are the main superficial differences between it and other American members of the same genus. The climatic differences in its wide range have developed several geographic races, none of which, however, show strongly marked characters.

This shrew appears to have a most catholic taste, so far as its surroundings are concerned, for it appears to frequent every type of situation where shelter and food can be found. It abounds among the peat beds and sphagnum mosses of the desolate barrens bordering on the Arctic coast, as well as amid the rotten stumps, old logs, fallen leaves, and other vegetable debris on the floor of the forests farther south. It will be found also in the rank matted vegetation about marshes, in old fields and occasional sphagnum swamps in the southern parts of its range.

The little tunneled runways of these shrews form a network in the beds of moss in a sphagnum swamp near Washington. In the forest the animals always seek the cover afforded by fallen logs, slabs of bark, or anything else that will give protection. On the coast of New Jersey they live so near the sea that an extra high tide forces them to mount the drift logs on the salt meadows for safety. They often make little burrows in the soft earth under the roots of a tree, a stump, or a log.

Their nests are small balls of dry leaves, grasses, or other soft vegetable material placed snugly under a log or in a hollow stump, burrow, or other good retreat, where they appear to have two or more litters of from six to ten young during the summer and fall.

As in the other shrews, the food of the common species consists mainly of insects, larvæ, worms, and obtainable flesh; but in winter and possibly at other seasons many kinds of food are eaten, including insects, meat, fat, flour, and seeds. During the years I passed at St. Michael, on the coast of Bering Sea, the beginning of winter always brought into the storehouses and dwellings a swarm of field mice, lemmings, and these shrews. The food requirements of all appeared to be the same, and all fed freely on the flour and other accessible stores. Dozens of the shrews were killed in the houses every winter.

Occasionally I caught and kept one captive for a time to observe its habits. It would be extremely restless and equally active by day or night. The small eyes appeared of little service, but the long, flexible snout was used constantly and served as the main reliance of the little beast for information as to the outside world.

Wherever they travel these shrews utilize the

runways of the field mice or other small animals and make little runs of their own only where necessary. Aside from a faint squeak, I have never heard them utter a sound, but other observers credit them with series of fine twittering notes apparently uttered as a song.

The common shrew is a solitary animal of so morose a disposition that if two are placed in a cage together they almost immediately fall upon one another with tooth and nail, and the victor devours the body of its companion at a single meal. The digestion of shrews is so rapid and the call for food so incessant that it requires constant activity to keep the demand satisfied.

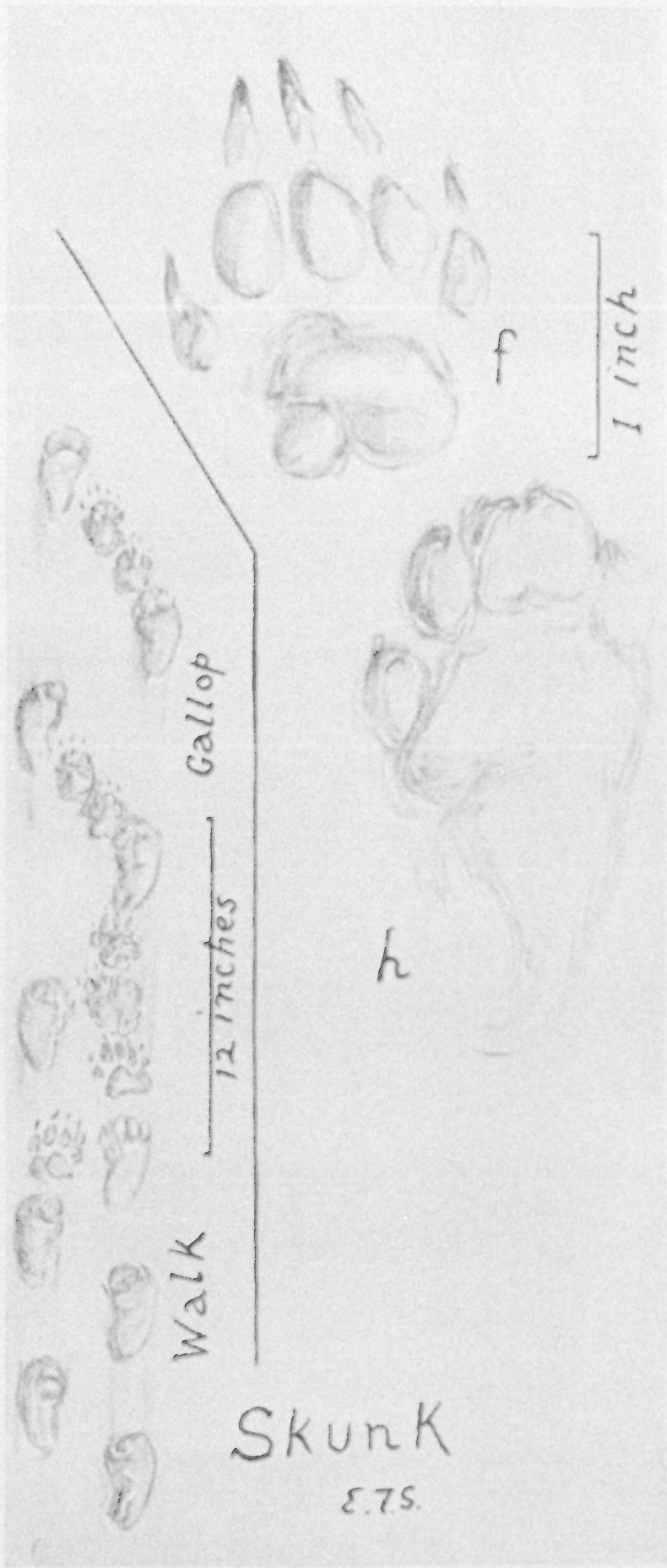
After the winter snow arrived in the North I found many tunnels of these shrews running just under its surface and raising it a little in a slight but distinctly rounded ridge. Such tunnels wandered widely and on the ice of the Yukon River I traced one of them more than a mile and repeatedly saw them crossing the river from bank to bank. It was surprising to note the ability of the little travelers under the surface to keep in so nearly a direct line for long distances.

At times these little adventurers make similar tunnels in the snow far out on the sea ice. The mythology of the Eskimos contains accounts of many supernatural animals which a lone hunter may meet and which have the power to do him deadly harm. Among these the "sea shrew" is one of the most malignant. Its appearance is described as exactly like that of the common land shrew, but it is said to live on the ice at sea, and if it sees a hunter to dart at him through the air, pierce the skin, and, after running all through the body with incredible rapidity, to enter the man's heart and kill him. In consequence of this belief the Eskimo hunters were in mortal terror if they chanced to encounter a stray shrew on the sea ice. I knew one hunter who suddenly meeting one on the ice stood motionless for hours until the shrew wandered out of sight. He then hastened home and all the other hunters agreed he had had a lucky escape.

THE SHORT-TAILED SHREW
(**Blarina brevicauda** and its relatives)

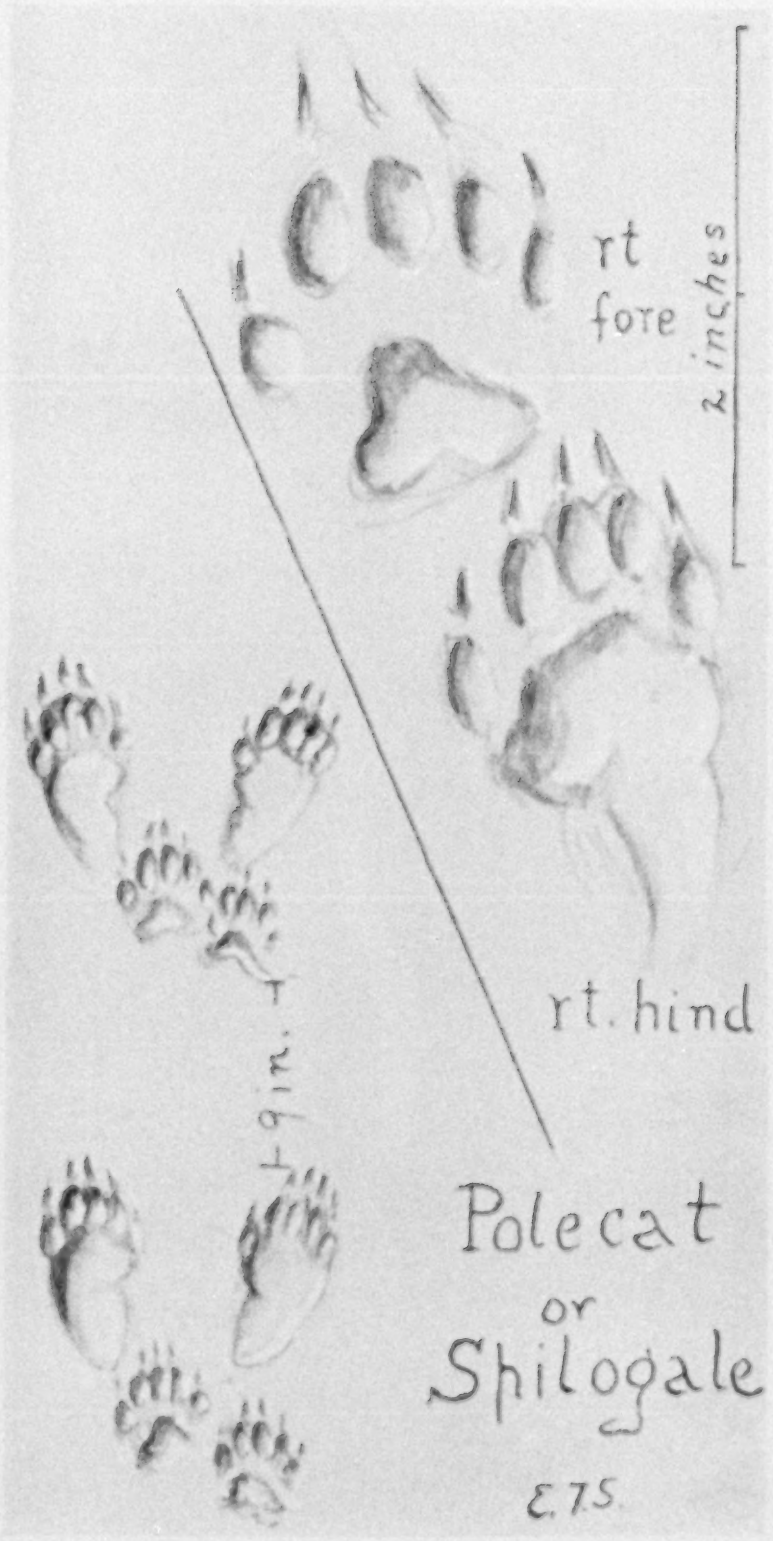
(*For illustration, see page 464*)

Several groups of species or genera of the little mouselike animals known as shrews are peculiar to North



THE TRAIL OF THE COMMON SKUNK

The hind foot of the skunk rarely shows the claws in the track. The diagonal set during the gallop is characteristic (see pages 456 and 477).



LITTLE SKUNK, POLECAT, OR SPILOGALE

This trail combines the characteristics of the skunk with those of a squirrel. At first it looks like the track of a stubby-toed squirrel, but the five-inch toe on the front foot is plainly seen. The frequent pairing of the fore paws is important. There is no tail mark (see pages 456 and 474).

America. Of these one of the most numerous and best known is the short-tailed shrew. It is a dark-colored animal much more heavily proportioned, larger, and with a shorter tail than the common shrew. Its fur is so thick and velvety that it is confused by many people with the mole, despite its smaller size.

The short-tailed shrews, sometimes called mole shrews, of the genus *Blarina* belong to a single species with several geographic races occupying eastern Canada and the United States, from Nova Scotia, southern Quebec, Ontario, Minnesota, and North Dakota southward to Florida and the Gulf coast as far as eastern Texas. Vertically they range from sea-level up to the tops of the Alleghenies. Another group of American shrews, containing numerous species belonging to the genus *Cryptotis*, occupies the mountains of the Western States, and ranges south to northern South America. In external form it is indistinguishable from the short-tailed species.

Probably no mammal is more numerous in the eastern United States than the short-tailed shrew. It occurs everywhere—in forests, in brushy areas, in old fields, and along grassy banks. Within the city of Washington it is common in Rock Creek Park, where it lives in covered runs which it makes among the grass and fallen leaves. These shrews drink frequently, and this may in part account for their abundance near streams or other water, although it may be the desirable moist soil conditions which draw them to such situations.

The runways of these shrews are scarcely half an inch wide, usually partly sunken in the mold or rotting surface vegetation. These are not made by digging, but by pushing aside the loose mold, and they cross and recross in an irregular network. They lead to the entrances to burrows which generally drop nearly straight down. The burrows are sometimes amid the leaves, but usually under the shelter of a root, stump, old log, or other cover. In addition to their own runways, the shrews make free use of the runs of meadow mice and even traverse the tunnels of the pine mice and moles in their restless search for prey.

Small rounded chambers opening off their underground runways are filled with fine grass, pieces of leaves, and other soft matter for a nest. One nest examined was made entirely from the hair of meadow mice, probably the spoils of war from the bodies of victims. As a rule, shrews are extremely unsocial, but a pair of this species is sometimes found occupying the same nest, no doubt a temporary arrangement. Several litters, containing from four to six each, appear to be born through the summer and fall, usually beginning in June.

While equally active by day and by night, the eyes of these shrews seem to be of little

use except to distinguish between light and dark, but their senses of hearing and smell are highly developed, as is also the sense of touch in their long hairs, or "whiskers," about the nose. In captivity an extreme sensitiveness is exhibited to sudden sounds, especially such as those of a bird's wings, indicating an instinctive fear born of age-long persecution by birds of prey. Food is located by smell, and as the flexible end of the snout is moved continually from side to side, odors are caught which may register conceptions as definite in the minds of these small animals as sight does in more favored beasts. All shrews are provided with musk glands and on account of these are apparently nauseous to most other animals, as they are rarely eaten by beasts of prey. These musky secretions must be of great service to facilitate them in locating one another.

Like other shrews and the moles, their digestion appears to be very rapid and they will eat two or three times their own weight in a day. This necessitates great activity on their part during much of the time in order to find the required food. They prefer insects and meat, but are practically omnivorous, feeding not only upon many kinds of insects, but on earthworms, slow-worms, sowbugs, snails, slugs, mice, shrews, and the young of ground-nesting birds, as well as such vegetable food as beechnuts, seeds, bread, and oatmeal.

The instinct of prevision against the season of winter scarcity appears to be developed in them, as one in captivity buried beechnuts in the earth, and they are known to store living snails in small piles and to gather disabled beetles in store-rooms in their tunnels.

The courage and blind ferocity of the short-tailed shrews when they are placed near captive mice far larger than themselves, is amazing to all who witness their encounters. They attack instantly, spreading their front feet to gain a firmer footing and moving forward in little rushes. Mice larger and much more powerful than the shrew are persistently attacked and, finally giving out, are pounced upon and the flesh torn from their heads and necks with ravening eagerness. One day a passing observer heard a loud squealing on a railroad bank where an examination revealed a short-tailed shrew dragging away a nearly dead pine mouse, though the mouse was much the heavier. The notes of the shrews are a fine tremulous squeak which becomes a longer, harsher, and more twittering or chattering cry when they are angry.

No cessation of their activity occurs in winter. When the cold weather begins many gather about barns and houses located near woods or old fields, and thus with the field mice take advantage of the garnered food supplies and shelter. Others remain in their regular haunts, where they frequently burrow long distances in the snow, making networks of tunnels and traveling long distances just below the surface, leaving little raised ridges like the track of a mole on the ground. Their journeys upon and under the surface of the snow appear to be in search of food, as they burrow down to old logs and stumps which make good feeding grounds. Their movements are very active, as they go about either at a walk or quick trot.

These fierce and truculent little hunters are wholly beneficial in their habits and should be encouraged in place of being killed on sight indiscriminately, as one of the ordinary mouse tribe.

THE RED BAT (Nycteris borealis)

(*For illustration, see page 464*)

Bats reach their greatest development in the tropics, where a marvelous variety of these curious mammals exist. To the northward the number of species gradually decreases, until eventually, in northern Canada and Alaska, a single species represents the group. The United States, occupying the middle latitudes, has a considerable number of different kinds. Some of these remain throughout the year, hibernating in caves during the period of cold, when insects are not to be had; others wing their way southward like birds on the approach of winter and return in spring.

All bats are nocturnal, although individuals of some species occasionally fly about for a time by day and many come out just before or soon after sunset. In this country practically all species are insectivorous, but in Mexico and the West Indies many are fruit-eaters and a few true vampires or blood-suckers.

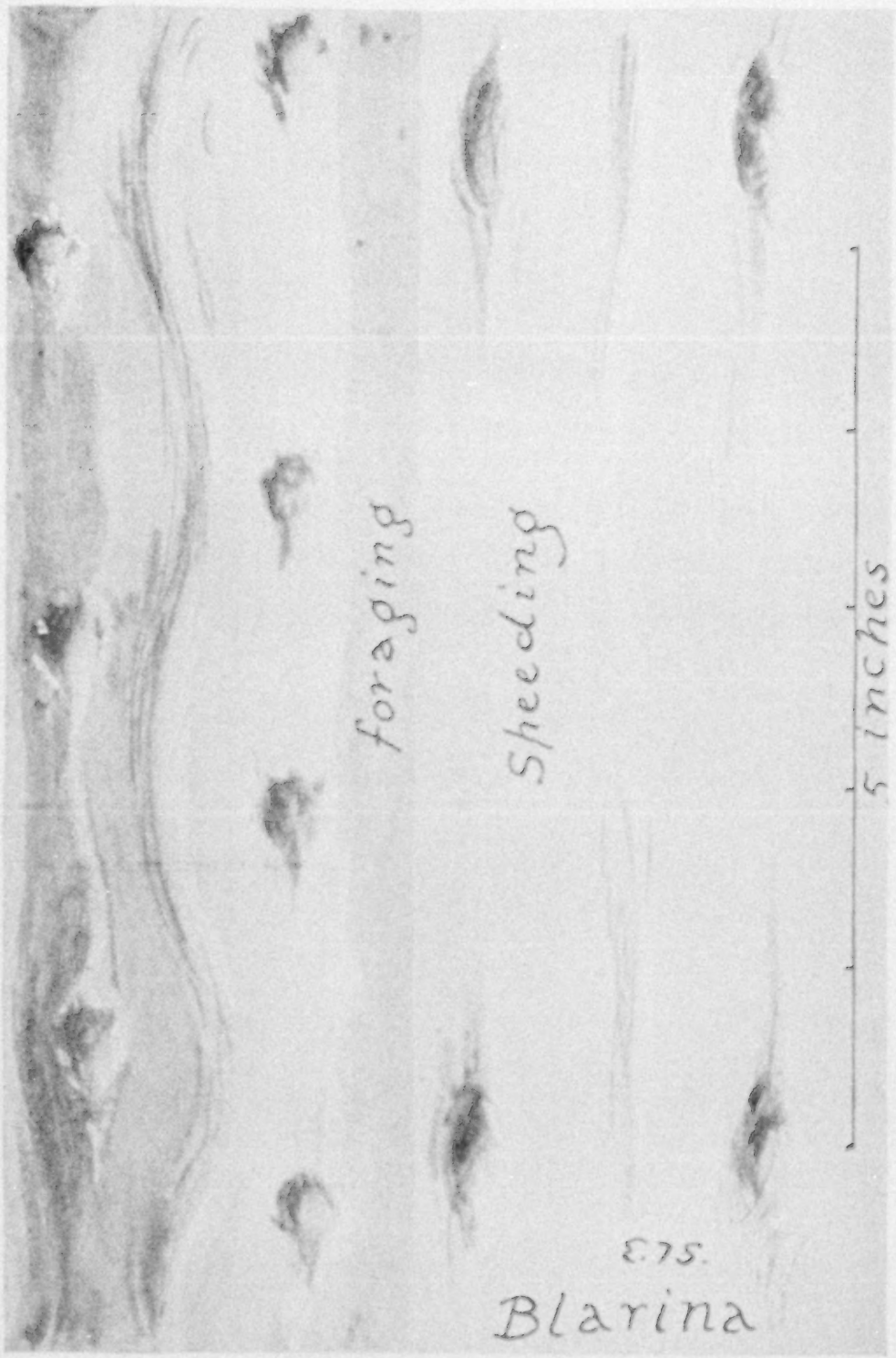
As a rule, bats are clothed in dull colors, but richly tinted coats give a few a more attractive appearance. Of these none has a more striking adornment than that presented by the soft covering of glossy orange-red fur of the red bat. Its large size, about four inches in total length, with a spread of wings amounting to twelve inches, combined with its color, suffices to distinguish it at once from any other northern species.

The range of the red bat extends from the Atlantic coast to the Pacific and from Ontario and Alberta in southern Canada south throughout most of the United States to the Gulf coast and southern California; also beyond our limits to Lower California and Costa Rica. The genus to which this bat belongs ranges more widely in other parts of North America; also to South America and across the eastern Pacific to the Galapagos and Hawaiian Islands.

The red bat rarely or never seeks shelter in gloomy caves and crevices, but hangs to the small twigs or leaf stems on trees and bushes in the full light of the sun. One observer in Texas on July 4 found four of them hanging in a cluster from a twig on a peach tree, with the sun shining full on them, although the temperature in the shade was 82 degrees Fahrenheit. I have found them in northern Illinois in the glaring sunlight of May, hanging from leaves in the tops of oak trees. This unusual tolerance of light in a member of the bat tribe is further shown by its habit of beginning to hunt through the air for insects earlier in the afternoon than other species in its range.

Long, narrow wings and swift, powerful flight

XUM



THE SHORT-TAILED SHREW, OR BLARINA

The curious grooved track in the snow with the tail mark is seen on the left (see pages 404 and 487)

characterize the red bats in the air. They have marvelous control in darting and turning here and there, and no birds, except possibly the chimney swifts, can equal them in their extraordinary gyrations.

Red bats are known to migrate from the northern part of their range in September or October and to return in May. They have been seen going south at Cape Cod the last of August and in September; and late in October Dr. E. A. Mearns has recorded great flights of them down the Hudson Valley, lasting throughout the day. That they share the vicissitudes of migrating birds is indicated by observation on the New Jersey coast of stray individuals coming in from the sea exhausted early on September mornings.

They are among the most solitary of their kind, usually being found hanging singly on a tree or bush, sometimes within a few feet of the ground. On occasion they gather in clusters as mentioned above, and in one instance in Maryland more than a dozen were hanging in a compact ball, which suddenly exploded into its winged parts when disturbed.

One of the most unusual characteristics of the red bat is found in the number of young it bears. Usually other species, except the hoary bat, have one or two young, but at varying dates between May and July each year the red bat produces from two to four, the average being three or four. The young when very small are carried clinging to the body of the mother in her flights. She continues to take them from place to place in this manner until their combined weight exceeds her own. The strength of the maternal feeling in this species is well illustrated by an instance in Philadelphia where a boy caught a half-grown red bat in a city square and carried it home. In the evening, three hours later, he crossed the same square, carrying the young bat in his hand, when the old one came circling about him and finally in her deep anxiety alighted on his breast. Both were brought in, the young one clinging to its mother's teat. The devoted mother received injuries when she was captured, from which she died two days later.

In the contact between mankind and bats, man, the invariable aggressor, finds the bats baring their teeth, biting viciously, squeaking, and behaving altogether like little fiends. A gentler side is sometimes exhibited, however, and one observer who caught a partly grown red bat found that it became tame, showed in-

telligence, and developed a friendly feeling for its captor.

THE HOARY BAT (Nycteris cinereus)

(*For illustration, see page 464*)

The hoary bat is a close relative of the red bat described above, but is larger, about five inches long, and, as its name implies, is of a different color. It is widely distributed over a large part of North America, where it is known to breed from Nova Scotia, Manitoba, and the southern shore of Great Slave Lake south practically throughout the United States. It is one of our larger species and is remarkable for its power and skill on the wing. The wings are long and narrow and carry their owner through the air in a bewildering series of swoops, curves, and zigzag turns remarkable even in a group of animals so notable for their powers of flight.

With the approach of cold weather the hoary bat migrates from the northern parts of its range to the milder southern districts. It is a late migrant, not leaving its northern home until the last of September or October and returning in May. Some individuals appear to remain in the North all winter, as one has been taken in Connecticut in December. In its southern flight it wanders as far as Jalisco, near the southern end of the Mexican table-land, to Lower California, and to the Bermuda Islands. To reach the Bermudas it is evident the bat must make a continuous flight from the nearest point on our shores of at least 580 miles—a good tribute to its wing power.

Like the red bat, it lives in the open, hanging from twigs and leaves in the tops of trees or bushes in the broad light of day rather than in the dark, stifling crevices where so many of its kind pass their lives. It appears to hang up indifferently on any convenient tree or bush, including conifers, aspens, or willows. During the day it has a curious lack of alertness, and as it is not rarely attached to low branches or bushes within a few feet of the ground it may be readily approached and taken in the hand. I once captured a fine specimen the middle of May, in southern California, hanging on a bush about four feet from the ground. It appeared to be sound asleep until taken by the skin on the back of the neck, when it became very much alive and, struggling in a fury, uttered grating shrieks of rage, baring its sharp, white teeth and trying desperately to bite.

Its food is made up entirely of insects, which it appears to hunt higher up than most bats, sweeping over the tops of the forest and in and out about the trees. It appears to be of even more solitary habits than the red bat and is nowhere so common. Another reason for our lack of information concerning it is found in its strictly nocturnal habits, for it rarely appears until shortly before the approaching night hides it from view.

The hoary bat shares with the red species the distinction of bearing from two to four young each year. The young are born in June and are carried attached to the underside of the mother's body until they become too heavy a burden. They hang to the teats with the greatest tenacity and apparently rely mainly on this hold to prevent being dropped as they are carried on the wild aërial hunting excursions. With the unusual fecundity indicated by the number of young, it is difficult to account for the scarcity of these bats unless their habit of hanging in the open, exposed to the elements and to other dangers, may cause a heavy mortality among them.

THE MEXICAN BAT (Nyctinomus mexicanus and its subspecies)

(*For illustration, see page 465*)

Reference has been made in several preceding sketches of this series to the mammals of tropical origin which have invaded our southern border. The Mexican bat is a notable member of this class. It differs in many curious ways from the bats with which it associates in tempera'e regions. It is smaller than any of the other three bats treated here and is strongly characterized by a flattening of the head and body which enables it to creep into a surprisingly narrow crevice in the rocks or elsewhere. The ears are broad and flaring and extend forward over the eyes like the visor of a cap, and the end of the tail is not confined within the membrane extending between the hind legs, but projects from it. Another pronounced characteristic of this bat and one highly disagreeable is the rank musky odor which it gives out. This pollutes the air about its harboring places, rendering it a most unwelcome guest.

Whoever has visited the Southern and Southwestern States or Mexico must have noted the offensive odor in many places about the verandas of houses and especially about old churches and other public buildings. This is the sign of occupancy placed on the premises by the Mexican bats, which, to the number of a few dozens or actually by thousands, as conditions permit, may lie snugly hidden in cracks and dark openings of all kinds about the roof and walls. No other bat in Mexico or the United States is provided with so strong an odor.

The Mexican bat is extremely abundant, probably exceeding in numbers any other species within its territory. It ranges throughout the tropical and lower temperate parts of Guatemala, Mexico, and across our border, throughout most of Texas, and east as far as Florida and South Carolina; in the West it also abounds both in town and country in the warmer parts of New Mexico, Arizona, and California.

Closely allied relatives of the Mexican bat abound throughout the warmer parts of Central and South America to beyond Brazil. The genus to which this species belongs is represented in the warmer parts of both hemispheres. It extends north in the Old World to southern Europe and also is found in the Philippines.

The abundance of the Mexican bat in some favorable places is almost incredible. At Tuc-

XUM

son, Arizona, I once saw them, a short time before dark, issuing from a small window in the gable of a church in such numbers that in the half light they gave the appearance of smoke pouring out of the opening. At times they occupy houses in such numbers that their presence and accompanying offensive odor render the places uninhabitable. At the town of Patzcuaro, near the southern end of the Mexican table-land, I saw two rooms in an old adobe house occupied by as many of them as could possibly hang from the rough ceiling. The owner considered their presence a valuable asset, as he collected and sold the guano for more than the rooms would have brought in rent. The bats congregate in even greater numbers in large caves. So numerous are they in certain caves in Texas that the owner reports an annual income of about $7,000 from the guano.

They are very plentiful by day in the thin crevices about the roof and walls of caves in the celebrated Ixtapalapa, or "Hill of the Star," beyond the floating gardens at the City of Mexico, and I also found them living in many of the marvelous ruins of Mexico, including Chichen-Itza, in Yucatan. Wherever they occur in numbers they may be heard frequently by day shuffling uneasily about and squeaking shrilly at one another.

When they first come out after sunset they usually fly away in a great stream, nearly all in the same direction, as though migrating. This course will probably be found leading to water, where they scoop up a drink from the surface before beginning their wonderfully erratic zigzags through the air in pursuit of insects.

From the colder northern parts of their range they migrate southward to milder climatic conditions or descend to lower altitudes. In Mexico, where they live up to above 8,000 feet altitude, they move down from one to two thousand feet. Their young, one at a birth, are born from April to May.

It has been claimed that the Mexican bat brings bedbugs to infest houses. This is untrue of this or any other bat. These animals have certain small parasites, some of which, resembling small bedbugs, have probably given rise to the belief mentioned. These parasites live only on the bats.

Within a few years considerable publicity has been given to the supposed possibility of utilizing bats to destroy mosquitoes and thus eliminate malaria from infested areas. One or more bat houses have been built at San Antonio, Texas, for the purpose of assembling bats in large numbers, and many untenable claims have been put forth concerning the benefit to be derived from their services. The Mexican bat is the species which abounds above all others at San Antonio and is the principal species which has occupied the bat houses near town. It is definitely known that bats often fly miles from their roosts when feeding and do not concentrate on any one kind of insect. Examination of the contents of the stomachs of Mexican bats shows that they feed on beetles and numerous other insects, but rarely upon mosquitoes. I have visited many Mexican towns and villages in which every house was haunted by numbers of these bats and where malaria was perennial. The evidence against these animals serving any useful purpose in checking malaria is conclusive.

It may be repeated here, however, that all of our bats are of high utility as insect-destroyers and should be protected. Among the many species of varying habits which exist in the United States, a few make their homes about houses in annoying numbers. In place of killing them to abate the nuisance, it would be better to exclude them from buildings by closing the entrance ways promptly after all have left in the evening, and thus by quiet eviction cause them to find abiding places elsewhere. The destruction of forests, and the consequent absence of the hollow trees where they formerly lived, is mainly responsible for bats and chimney swifts coming to houses for harbor.

THE BIG-EARED DESERT BAT (Antrozous pallidus and its relatives)

(*For illustration, see page 463*)

The marvelous variations in structure of the ears and other organs about the heads of insect-eating bats serve probably as microphones by which the flight of their prey may be detected and its direction located with instantaneous certainty. The beautiful accuracy with which this hearing mechanism works must be evident to any one who will take a position where he may have the evening glow of the western sky as a background for flights of bats. It is certain that the small and ineffective eyes these animals possess could never locate their minute flying game and enable them to secure it in the whirling, zigzag courses they pursue, often at a speed and under a control which few, if any, birds could rival.

The great ears of the big-eared desert bats illustrate one form of a highly developed hearing apparatus and give these animals a handsome and strikingly picturesque appearance. This character at once distinguishes them from others of their kind in the United States.

The distribution of this species lies mainly in the arid parts of the Southwestern States and Mexico. It extends from western Texas, southern Colorado, Nevada, and Oregon, south to Queretaro, on the Mexican table-land, and to the southern end of the peninsula of Lower California. The vertical distribution extends from sea-level up to at least 5,000 feet altitude.

By day these desert bats live in crevices and caves in cliffs, in old mining tunnels, hollows in trees, and in sheltered places about the roofs and walls of houses, barns, or other buildings. Their presence in dark hiding places may sometimes be detected by occasional grating squeaks. They appear to lack any musky odor which characterizes so many bats. About the 1st of June each year either one or two young are born, and for a time these cling to the mother's

breast and are carried during her swift flights in pursuit of insect prey.

Often when camping at desert waterholes, I have seen them come in just before dark to drink, scooping up water from the surface while in flight, and then circling back and forth over the damp ground at an elevation of a few yards for the capture of some of the insects common in such places. At such times, with the distant hills mantled with a deepening purple haze and the pulsating heat of the day replaced by the milder temperature of approaching night, these bats could often be seen sharply outlined against the rich orange afterglow of the departed sun. Here and there in the still air flickered and zigzagged multitudes of tiny bats, like black butterflies, and among them the occasional big-eared bats on broad wings appeared huge in contrast. Their wing strokes were slower and shorter than those of the smaller species and impelled them forward in a swift, gliding movement which gave their evolutions a sweeping grace beautiful to see.

In August several years ago, during a visit to the Indian School at Tuba, in the Painted Desert of northern Arizona, I found these bats living in considerable numbers about the buildings. Just before dark they swarmed out and hunted about the surrounding orchards and small fields. One evening my collector shot at one as it circled over a potato field in a small orchard. It continued its flight, circling low among the apple trees as though unhurt, when suddenly it dropped to the ground. Supposing the bat to be wounded, it was cautiously approached and covered with a hat, when, without a struggle, it permitted itself to be picked up by the nape. It then became evident that the bat was unhurt from the shot. The reason for its sudden descent was revealed in the person of a large, fat mole cricket (*Stenopalmatus fuscus*) which it was holding firmly in its jaws, and so ferociously intent was it in biting and worrying its luscious prey that it paid not the slightest attention to its captor. Finally it was killed by having its chest compressed and died with its bull-dog grip on its prey unbroken.

These bats, like the other members of the tribe in the United States, are fully as beneficial to the farmer as the best of our insect-eating birds and deserve equal protection in place of the general persecution from which they now suffer.

INDEX TO SMALLER MAMMALS OF NORTH AMERICA

TEXT AND ILLUSTRATION PAGES

	Text	Color Illustration	Track Illustration
Armadillo, Nine-banded	480	457	....
Bat, Big-eared desert	492	465	....
Bat, Hoary	491	464	....
Bat, Mexican	491	465	....
Bat, Red	489	464	....
Beaver, Mountain	427	432	....
Cat, Common	...	...	385
Cat, Ringed-tailed	482	460	....
Chipmunk, Antelope	443	437	....
Chipmunk, Eastern	447	440	477
Chipmunk, Golden	443	440	....
Chipmunk, Oregon	450	441	....
Chipmunk, Painted	451	441	....
Cony, Little chief hare, or Pika	392	409	....
Ferret, Black-footed	469	449	....
Gopher, Pocket	398	413	....
Hare, Arctic	389	408	....
Hare, Little chief, Cony, or Pika	392	409	....
Hare, Varying, or Snowshoe rabbit	387	405	388
Kangaroo rat	400	416	....
Lemming, Banded	401	417	....
Lemming, Brown	402	417	....
Marmot, American, or Common woodchuck	431	432	475
Marmot, Hoary, or Whistler	434	433	....
Marten, or American sable	473	453	....
Mink, American	472	453	482, 483
Mole, Oregon	484	461	....
Mole, Star-nosed	485	461	....
Mouse, Beach	422	428	....
Mouse, Big-eared rock	423	429	....
Mouse, Field or Meadow	403	420	393
Mouse, Grasshopper	418	425	468
Mouse, Harvest	415	425	....
Mouse, House	427	429	....
Mouse, Jumping	394	412	....
Mouse, Pine	406	420	....
Mouse, Red-backed	407	421	....
Mouse, Rufous tree	416	421	....
Mouse, Silky pocket	395	413	....
Mouse, Spiny pocket	396	413	....
Mouse, White-footed	419	428	470
Muskrat	411	424	467
Nature's wild folk	...	...	383
Pika, Little chief hare, or Cony	392	409	....
Polecat, Spilogale, or Little skunk	...	...	488
Porcupine	393	412	....
Prairie-dog	434	436	....
Rabbit, Antelope jack	384	404	386
Rabbit, California jack	385	405	386
Rabbit, Cottontail	390	408	390
Rabbit, Marsh	391	409	....
Rabbit, Snowshoe or Varying hare	387	405	388
Rat, Brown	423	429	472
Rat, Kangaroo	400	416	....
Sable, American, or Marten	473	453	....
Shrew, Common	486	464	....
Shrew, Short-tailed	487	464	490
Skunk, Common	477	456	487
Skunk, Hog-nosed	479	457	....
Skunk, Little spotted	474	456	488
Squirrel, Abert	462	448	....
Squirrel, California ground	439	437	....
Squirrel, Douglas	455	444	....
Squirrel, Flying	466	449	....
Squirrel, Fox	459	445	478, 479
Squirrel, Gray	458	445	....
Squirrel, Kaibab	462	448	....
Squirrel, Red	454	444	....
Squirrel, Rusty fox	459	445	478
Squirrel, Striped ground	438	436	....
Stoat, or Large weasel	469	452	....
Weasel, Large, or Stoat	469	452	481
Weasel, Least	471	452	....
Whistler, or Hoary marmot	434	433	....
Woodchuck, Common, or American marmot	431	432	475
Woodrat	414	424	....

XUM

THE NATIONAL GEOGRAPHIC WAR-ZONE MAP

THE MAP of the western theater of war appearing in this issue of the NATIONAL GEOGRAPHIC MAGAZINE fills a long-felt need. Existing maps available to the casual student of the war's progress have scales and letterings which preclude the use of more than half of the place names in the war zone. But it often happens that a little village of a score of houses, which has never attained to the dignity of mention on the maps of general circulation, figures more prominently in the news from the front than a place of several thousand population.

Therefore the National Geographic Society decided to bring out a map in which practically every name in the battle area, however unimportant, might have its place. The only maps extant answering to this demand are the big official maps of the French and Belgian Departments of War, made in sections and projected on a scale of approximately three miles to the inch. Of course, to reproduce them on that scale would make a map altogether beyond the compass of convenience. It would cover 3,960 square inches and would be too large even for a wall map, as one studying it would either have to get down on his knees or up on a stool to read it from top to bottom.

How to condense the information of more than 27 square feet of map into a little more than five square feet without destroying its legibility was the problem confronting those in charge of the undertaking. As the battle area is only about a hundred miles wide at the widest, while the battle line is some four hundred miles long, another problem was so to divide the line into two sections and so to arrange these sections that 400 miles of battle line could be put into a map on a scale of approximately seven miles to the inch and of convenient size.

Battle lines as of specific dates have been omitted because the line is always changing; the map showing it is out of date in a few weeks. But by reference to the inset map the lines in the fall of 1914 and the spring of 1918 can be fixed. By starting in at Dunkirk and underscoring each principal city along the battle line in red—taking Ypres, Arras, Bethune, Amiens, Montdidier, Noyon, Laon, Rheims, Soissons, Verdun, Lunéville, Nancy, Toul, etc.—the general trend of the line may be followed. If the reader will remember that the news speaks of this sector and that, corresponding usually to these principal names, little trouble will be experienced in locating places. For those who want to study the map in detail, however, an index has been prepared.

As the squares into which the map is laid off are ten miles each way, and therefore contain one hundred square miles of territory, the reader can easily estimate the terrain lost or won in any given drive.

In this map the aim has been to combine legibility with completeness, and except in one or two sections, where names were so thick that even with the small lettering used they could not all be put in, the reader will always find the place he is looking for. Fully 95 per cent of the names mentioned in the daily news appear on this map.

The excellence of the map is due to the patient perseverance of the Society's chief cartographer, Mr. Albert H. Bumstead, who met and overcame many unusual obstacles in the production of a readable map containing a maximum of information in a minimum of space, and to the unusual photographic work of Mr. Charles Martin, chief of the Society's photographic laboratory.

Those desiring the index can obtain it by remitting 25 cents to the National Geographic Society, 16th and M Streets, Washington, D. C.

Additional copies of the map can be obtained at 75 cents each (including index) and of a special edition, printed on linen-back map paper, at $1.50 each (including index). Foreign postage, 50 cents.

Additional copies of this May issue, postpaid, 75 cents each in the United States.

No master record shall be considered as satisfactory and complete and perfect until it has been approved not only by an authorized representative of the Victor Company, but also by the artist.

Extract from Victor artists contract

Every Victor Record must have the artists own approval

Our contract demands it

Not only must every Victor Record receive the approval of the Victor Recording Laboratory before it is listed in the Victor Record catalog, but *the artist who makes the record* must also be satisfied that it portrays his or her art with absolute fidelity. When you play a Victor Record on the Victrola, you can be sure the interpretation you hear is exactly as the artist sang or played it—*exactly as he or she wishes you to hear it.*

So true to life in every detail that Victor Records have also earned for themselves the universal and enthusiastic approval of the great final judge—the music-loving public.

There are Victors and Victrolas from $12 to $950, and any Victor dealer will gladly demonstrate them and play your favorite music for you. Saenger Voice Culture Records are invaluable to vocal students—ask to hear them.

Victor Talking Machine Co., Camden, N. J., U. S. A.
Berliner Gramophone Co., Montreal, Canadian Distributors

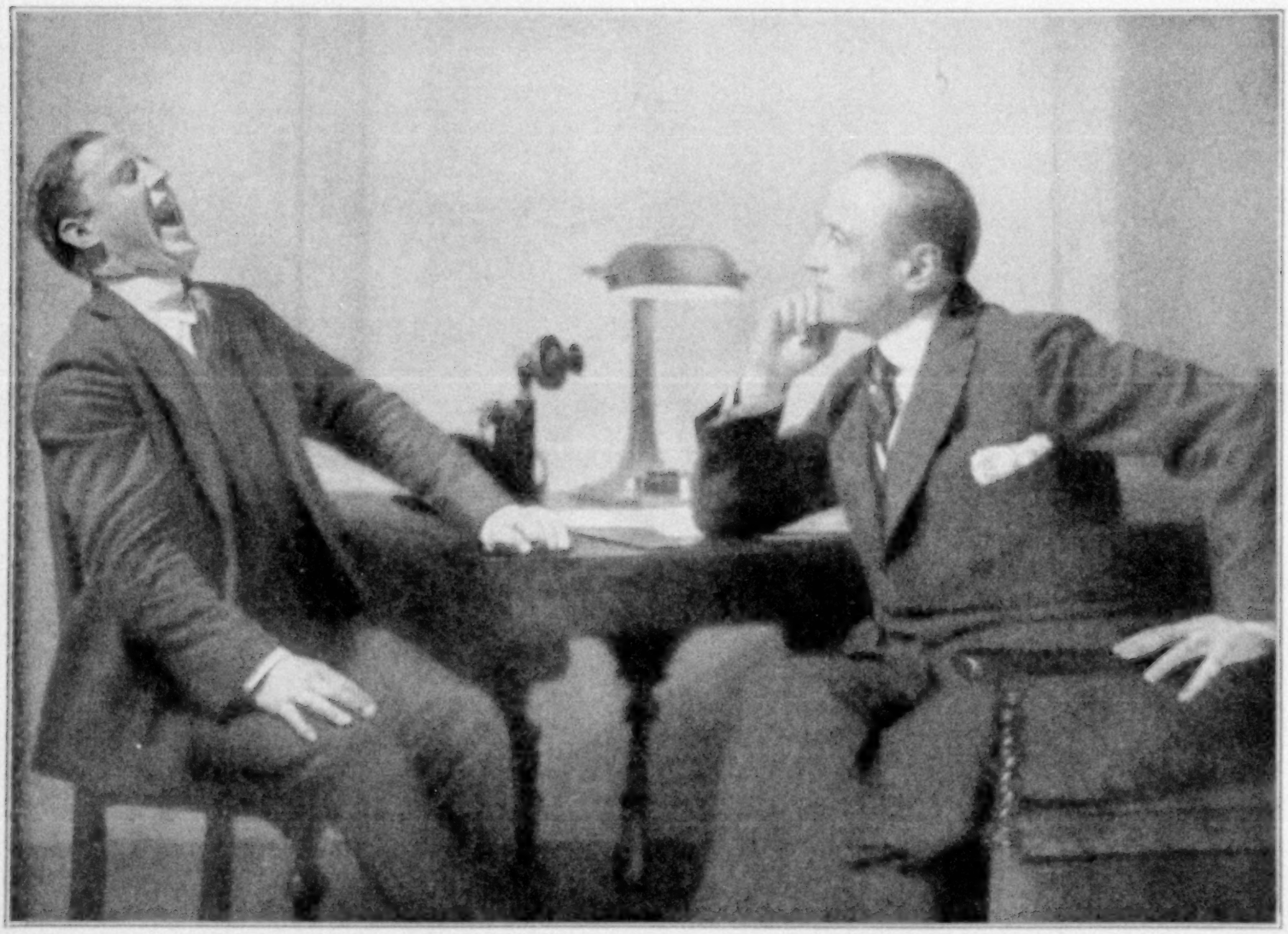
Important Notice. Victor Records and Victor Machines are scientifically coordinated and synchronized in the processes of manufacture, and their use, one with the other, is absolutely essential to a perfect reproduction.

New Victor Records demonstrated at all dealers on the 1st of each month

"Victrola" is the Registered Trade-mark of the Victor Talking Machine Company designating the products of this Company only.

"Mention the Geographic—It identifies you."

XUM



What made Johnson laugh—

QUINN hitched uneasily in his chair. "I wish, Johnson," he said, "that you insurance men wouldn't use the word 'risk' to describe my property. It's an unpleasant word and I don't like the sound of it."

"Everything we insure is a 'risk,'" said Johnson.

"Yes, I know; but it isn't a fair name for a place like mine. Just consider this property a moment: Here I've got concrete walls and floors, wire-glass windows, isolated stairways and elevator-shafts. What does the risk of fire amount to here?"

"You're paying a rate of $1.00 per hundred, aren't you?" asked Johnson.

"Yes."

"Well, there are half a dozen firms in town that are paying only 25 cents. Some of them only 10 cents."

"Yes, that's what makes me so sore," snapped Quinn. "There is Henry Simpson, on the other side of the river; he's got a brick-and-wood plant that is forty years old and he's getting a rate of 30 cents. I can't see the reasonableness of it."

"That means that your plant is about three times as liable to burn up as his," said Johnson.

"But *why?*" persisted Quinn. "Look at those dry old wooden floors of his and that mass of kindling in his shipping-room. Why, I could go over there and strike a match and the place would be a heap of smoking ashes in twenty minutes."

Johnson threw back his head and roared.

"That's pretty good! Ha-ha-ha-ha-ha!

"Why, man, if you started a fire in his place you'd stand a good chance of getting half drowned in about two minutes!

"Go try it some time and see! Ha-ha-ha-ha-ha! Take a piece of oily waste and light it with your precious match and throw it into that room full of kindling and see what happens!

"In about half a minute you will have a cheerful blaze about the size of a barrel, but there will be a little click up near the ceiling and your nice little fire will be deluged with a drenching downpour of rain, the alarm-bells will be ringing all over the plant automatically, and the Fire Department will be coming on the run!"

"Is that what happened over there when that crazy little Austrian—"

"Yes," chuckled Johnson. "When Simpson started in on Government orders, that little Austrian conceived it to be his loyal Austrian duty to burn the place up. He started two lively fires—and automatic sprinklers nabbed both of them on the spot."

"Yes, *I* can see that Simpson would have to have sprinklers in *his* plant because it is full of fire-hazards. But here in this plant of mine there isn't a fire-hazard to be found anywhere!"

Again Johnson laughed. "I'm afraid you couldn't get a job as an inspector of fire-risks. You don't know a fire-hazard when you see one."

"But tell me—just tell me: how can this reinforced-concrete building burn down?"

"It can't; but what of it? Neither can a stove burn down. But you can have a lovely hot fire in a stove and you can have a lovely hot fire in this concrete grate of yours.

Why it is called a "Risk"

"To begin with, consider your neighbors: This man to the west of you keeps his oil-tank close to the boundary-line; on the north there's a fellow with an old wooden mill; on the east is the railroad with its sparks and embers and all kinds of cargoes; across the street is a row of tenements with all kinds of tenants, and rubbish in every cellar. Such exposure-hazards account for 28 per cent of all the fires.

"Then comes friction—hot bearings, overheated belts in the presence of oil. And you've got lubricating oil and oily waste, a favorite cause of spontaneous combustion.

Risk, Risker, Riskest

"You've got hot steam-pipes and radiators and you can't be sure that garments or inflammable goods will not be placed next to them. Then there's lightning and sparks, which are responsible for 7 per cent of the fire-loss in America. Matches and tobacco, of course. Gasoline and paint. Defective or worn-out electric wiring.

"And finally the unknown causes, which are more than 25 per cent of them all.

"There's nothing in this world that will prevent fires from occurring, even in the best-regulated property."

"You make it seem rather hopeless," said Quinn.

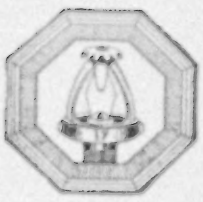
"No, not at all. While there's no infallible protection against fires *starting*, there is absolute protection against fires *spreading*.

"You must adopt the remedy. With this fine building your rate will be about 12 cents, if you put in sprinklers. The average fire-loss under sprinklers is negligible."

"They cost too much," ventured Quinn.

Johnson looked at him shrewdly. "Don't theorize—*get the figures*," he said. "Why, man, sprinklers will earn money for you! You can't afford to be without them, and you can't afford to get any but the best. Send for a copy of the Grinnell Exemption Blanks and let them tell you how much sprinklers will *save* you in *cash* each year."

Now, Mr. Reader, to get the figures, just write to the General Fire Extinguisher Company, 293 West Exchange Street, Providence, R. I.



GRINNELL

AUTOMATIC SPRINKLER SYSTEM

The Factory-Assembled System

Three Belt-Buying Basics

Leather

Of all belting materials, leather is pre-eminent for long wear under hard usage; for frictional grip on pulleys; for standing the strain of main drives and the side-slap of shifters; for ease of repair and splicing; for minimum power-leakage; for that *light-weight* pliability, firmness, and elasticity which good belting must possess.

Tannage

Belting leather requires a special tannage. We tan nearly 300,000 hides a year for belting use, giving you two great advantages: All our belts are of leather of the best possible quality for belting requirements. Our enormous stock of hides enables us to maintain a uniformity throughout our product that can be assured in no other way.

Standardization

Power transmission needs fall into comparatively few classes. For each one there is a Graton & Knight Standardized Belt. That means a belt which is scientifically built for exactly the class of duty to be performed. It is kept uniform. It pays us to make it standard for quality. It pays mill-owners to make it standard for use.

Many plants ask us to specify all their belting. Try the plan. Ask for "Graton & Knight——Brand or equal." This won't commit you to our belts, but puts buying on the one basic consideration — *the work to be done.*

Write for information about Standardization as applied to Belting

The Graton & Knight Mfg. Company, Worcester, Mass., U. S. A.

Oak leather tanners and belt makers

Branches and distributors in principal cities

24-inch Spartan Double Leather Belt on Motor Drive at Bosch Magneto Co., Springfield, Mass.

GRATON AND KNIGHT

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use

This Badge of Honor to be given every U. S. Shipyard Volunteer

Talk it over with your men

The outcome of the war depends upon SHIPS!

When we can build ships faster than the U-boats can sink them, the submarine peril will vanish—and America's might will win the war.

This is why the Government's call to enroll 250,000 skilled workers for the shipyards is so urgent; so vital.

Every employer is asked to help.

Will YOU make some sacrifice, so that the Government can get the skilled men required? Talk it over with your employees; explain the great need to them, and if some of them wish to enroll in the United States Shipyard Volunteers, make it easy for them to help the Government.

They will be paid good wages, millions are being spent by the Government to give them good homes; they will work at trades for which their experience has fitted them; they will come back to you better, faster workers. Every Volunteer will receive a badge and a certificate, showing that he is doing his bit for America.

You can perform no greater patriotic service to your country than by helping to build ships. Greater than the need for money, is the need for men—skilled men.

Will you help?

Mail the coupon today—get all the facts—and talk it over with your men.

For Further Information Mail This Coupon

EDWARD N. HURLEY, Chairman
U.S. Shipping Board, Washington, D.C.

Please tell me how I can help the Government enroll 250,000 Shipyard Volunteers.

Name.....

Address.....

Firm Name.....

U. S. Shipyard Volunteers

This page contributed to the Winning of the War by the
AMERICAN TELEPHONE AND TELEGRAPH COMPANY

Shelltex Rimmed

Shur-on

EYEGLASSES AND SPECTACLES

YOU'LL find that many of your friends wear Shelltex Shur-ons. Why? Because they find them good-looking, comfortable and economical. Try them yourself, and prove it.

The genuine (made only by Kirstein) bear the name Shur-on or Shelltex in the bridge. At your dealer's

E. KIRSTEIN SONS CO.
249 Andrew Street, Rochester, N. Y.

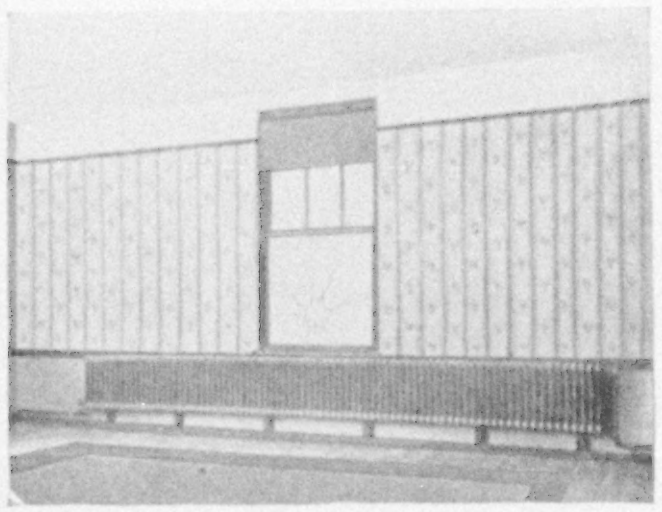
Makers of rimmed and rimless Shur-on eyeglasses and spectacles. Established 1864.

JUDD & DETWEILER, Inc.

Master Printers

420-422 Eleventh Street N.W.

WASHINGTON, D. C.



Does your heating guaranty say anything about economy?

There is so little difference in "efficiency" between the standard makes of heating apparatus that your contractor will freely guarantee any of them—if it's large enough.

But why the oversize? Simply because your contractor has to play safe if he wants to fulfill his guarantee. He knows that there will be a steady leakage of cold air *into* and a corresponding leakage of heated air *out* of your building the whole winter through; so he is compelled to make it oversize to meet these conditions. You pay for the oversize in excessive and unnecessary fuel bills.

To make your heating apparatus truly efficient—to get value received in comfort and warmth from your coal pile—equip every door and window with

MONARCH
Metal Weather Strips
and stop the leaks

Let winter's blast blow over and around, but not through, your house. Get our estimate *now*. Let our licensee show you why Monarch strips are the only weather strips that can be applied to new or old buildings with the certainty that your building will be "weather-proof" despite any after-changes due to shrinkage, swelling, or settling.

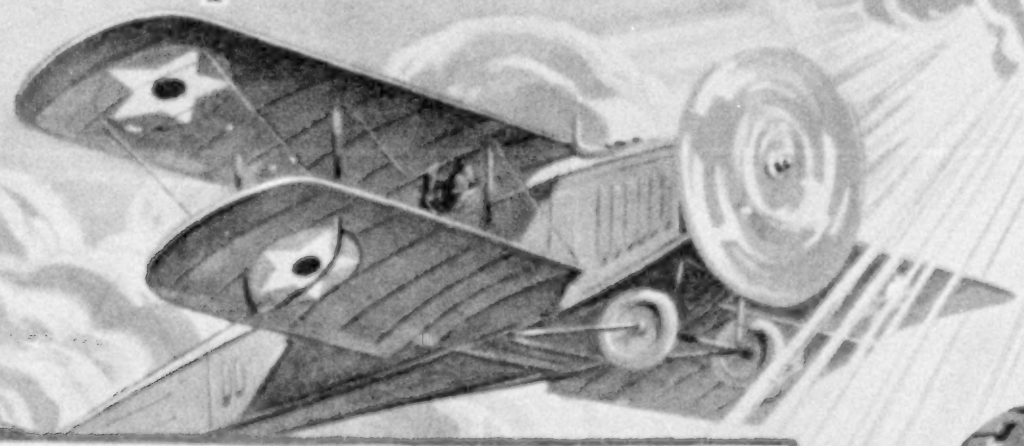
Send for our book, "Evolution of the Window." It shows how you can turn a steady loss into a live profit.

Monarch Metal Weather Strip Co.
4100 Forest Park Boulevard St. Louis, Mo.

BEST IN THE LONG RUN

FAIR TREATMENT

War-planes Enlist Silvertowns



GOODRICH TESTED TIRES

FROM mastery of road travel on earth, Goodrich Silvertown Cords have risen to tire mastery of travel in the air.

War-planes are being equipped with special tires of the spiral-wrapped, cable-cord tire body, the patent-protected body found only in Silvertowns, the tires trade marked with The Red-Double-Diamond.

Actual war service unfolded the matchless superiority of cable-cord for aeroplane tires.

To absorb shock without damage to delicate mechanism of their aeroplanes, aviators found they must have tires of maximum resilience, combined with great strength. On account of its sturdy cable-cord tire body, only the Silvertown type has such strength.

By the same token, **SILVERTOWN CORD TIRES** give the acme of comfort and tire service on the road. It is a sure service, proved along with the service of **BLACK SAFETY TREADS**, in the nationwide, 4,178,744 mile road tests of Goodrich Test Car Fleets.

THE CITY OF GOODRICH · AKRON, OHIO.

POCONO MODEL

THATCH MODEL

Get a Cozy, Picturesque Bossert House

PUT it up in your favorite vacation spot—on the shore of a lake, in the woods—anywhere! Enjoy all the pleasure of outdoor life without any of its discomforts! Be independent of the big expense of living at summer resorts! It is a sensible war-time economy that will save money for you and add to your pleasure every summer for years to come. Figure the cost of several summers for your family at even the most moderate hotel or boarding-house rates! Contrast this with the low cost of a Bossert House—*a summer home that you will own.*

IT IS A MOST SIMPLE MATTER TO PUT UP

Bossert Houses

Any one can do it. No expert labor necessary. Shipped in sections, already painted and even with hardware fitted, all you need do is assemble the parts.

Bossert Houses can be sold at their low cost because of our standardized method of manufacturing and purchase of materials in tremendous quantities. You are given the benefit of the savings effected.

You assume no risk whatever in buying a Bossert House. We insist upon every purchaser being absolutely satisfied.

See the complete line of architecturally beautiful Bossert Houses at a wide range in prices. Send 18c today for handsome catalog containing illustrations, descriptions, and complete information.

All details of Bossert construction are fully covered by U. S. patents

LOUIS BOSSERT & SONS, Inc. ... 1313 Grand Street, Brooklyn, N.Y.

McK&R

Letter from a prominent dentist whose name will be given on request

"I much prefer a *powder*, and am convinced that it is the most efficient form of dentifrice"

CALOX

THE OXYGEN TOOTH POWDER

A package, sufficient for one week's trial, and authoritative booklet telling "Why a Tooth Powder is Better Than a Paste," will be sent free on request.

"Your 32 Teeth are 32 Reasons"

McKESSON & ROBBINS, 91 Fulton St., New York
Incorporated

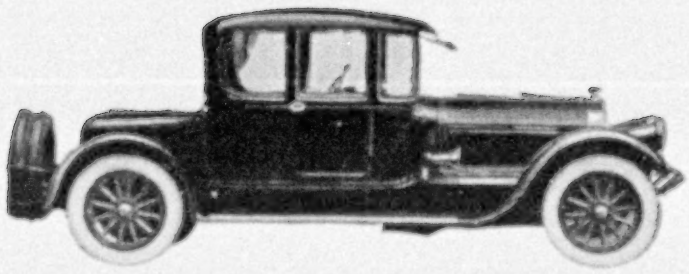
"Beautiful Birch for Beautiful Woodwork"

"Our House"

THE most interesting discussion that can come up in the family circle is about "our house," as it will look when ready for occupancy. An important part of the plan is the interior trim—that part of the house you live *with*. In solid woodwork, and veneered doors and wall panels "Beautiful **birch**" is the solution of the interior trim problem—Beautiful "satiny" sheen, due to close grain admits of finest variety of finishes including white enamel. Hard, marproof—*economical*—**birch** is a *universal* favorite with home builders—You'll say so, *too*—

FREE *Sample panels big enough to show different finishes and handsome* **birch** *book. Sent free. YOU should KNOW* **birch** *before YOU build. Write us.*

NORTHERN HEMLOCK AND HARDWOOD MANUFACTURERS' ASSOCIATION
214 F. R. A. BUILDING OSHKOSH, WISCONSIN

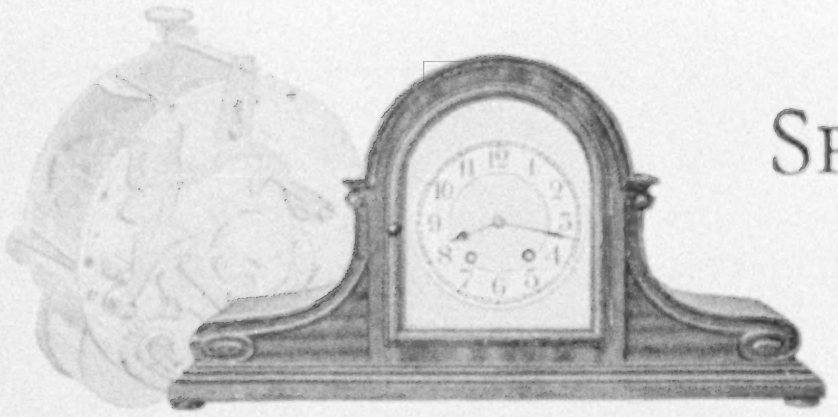


This Pierce-Arrow Coupe is 6-cylinder, 48 horse-power and 142 inches wheel-base. It is made in either two- or three-passenger models. The top is permanent and enclosed.

Pierce-Arrow

Look at this matter of buying a car as you would at any other investment. Its wisdom depends, not upon the amount of money spent, but upon the soundness of the investment.

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.



SETH THOMAS CLOCKS

The PEMBROKE

Mahogany case with four and one-half inch silvered dial, ten inches tall and eighteen inches long. Fifteen-day pendulum movement, striking hours and half-hours on a soft-toned Cathedral bell.

The First Seth Thomas Clock Was Made In 1813

Out of the severest tests of time, Seth Thomas Clocks have emerged with an enviable record for honest, accurate, faithful performance. The very name, Seth Thomas, symbols today the spirit of dependable time-keeping service. The quiet efficiency of Seth Thomas movements is in harmony with the dignity and artistry of the casings.

Your jeweler will be pleased to show or procure for you the PEMBROKE, pictured here, or any of the other clocks illustrated in our new catalog.

SETH THOMAS CLOCK COMPANY, NEW YORK

RECOMMENDATION FOR MEMBERSHIP

in the

National Geographic Society

The Membership Fee Includes Subscription to the National Geographic Magazine

DUES: Annual membership in U. S., $2.00; annual membership abroad, $3.00; Canada, $2.50; life membership, $50. Please make remittances payable to National Geographic Society, and if at a distance remit by N. Y. draft, postal or express order.

Please detach and fill in blank below and send to the Secretary

_____ 191

To the Secretary, National Geographic Society,
Sixteenth and M Streets Northwest,
Washington, D. C.:

I nominate _____

Address _____

_____

for membership in the Society.

_____

_____

5-18 (Write your address)

Why the Franklin Car Delivers Service Without Waste

THERE was a time when peace and plenty fostered a "hang-the-expense" attitude on the part of the automobile owner. That time has gone.

The national need of economy has brought the whole motor car proposition squarely down to a basis of: Service without Waste.

With the Franklin Car, this standard of Economy is not a new phrase, lugged in to meet the demands of the times.

From the beginning, the Franklin has held to the truth that heavy weight in a motor car is bound to mean heavy expense to run it—that needless *weight* directly results in needless *waste*. And today the car that is too heavy for a man's needs, is recognized as making unnecessary demands on the Nation's resources.

For sixteen years, the Franklin has been built on the principles of Scientific Light Weight, Direct Air-Cooling and Flexible Construction. For sixteen years, the Franklin has been piling up remarkable economy records as positive proof of the correctness of those principles.

Franklin efficiency has *always* been a recognized fact; the exacting nature of the times has simply extended that recognition.

For the average motorist no longer has a mere academic interest in gasoline economy. *He's hunting for it.* No longer is he satisfied with five, or even six thousand miles, to the set of tires. *He's looking for more.*

In sharp contrast to *claims* of economy—to mere assurances—he finds the strongly supported *facts* of Franklin *daily performance:*

> 20 Miles to the gallon of gasoline—instead of 10; 10,000 Miles to the set of tires—instead of 5,000. A high resale value—instead of a fire-sale price.

And he inevitably develops a new standard of motoring. He will never again tolerate the wastage of an inefficient car.

For it is not unusual to own a fine car; nor even unusual to own an economical car; but to own a car that is both fine *and* economical, is so unusual that it is possible in only one automobile.

FRANKLIN AUTOMOBILE COMPANY, SYRACUSE, N. Y.

XUM

HIS DINNER HAS JUST SLIPPED FROM HIS GRASP! AN OSPREY, OR FISH HAWK, RISING FROM A STRIKE

Make Friends with Nature's Feathered Wards in

THE BOOK OF BIRDS

200 Pages, Illuminated with 250 Matchless Subjects in Full Colors, 45 Illustrations in Black and White, and 13 Striking Charts and Maps

No other Nature-book ever published at a moderate price equals The Book of Birds in the beauty of its illustrations, the fascinating quality of its authoritative text, and the charming intimacy with which it introduces the reader to shy Friends of Forest and Countryside, Seashore and Upland.

The three principal divisions of this beautiful book are the contribution of the gifted ornithologist and facile author, Henry W. Henshaw, formerly Chief of the United States Biological Survey. Dr. Henshaw possesses to a marked degree the rare faculty of describing the haunts and habits of Nature's wild creatures with the ease and grace of the born story-teller and with the insight and knowledge of the scientist equipped by wide experience and exhaustive research. And no author has ever had a more gifted or more sympathetic illustrating collaborator than has Dr. Henshaw in the noted naturalist-artist, Louis Agassiz Fuertes, whose 250 bird portraits, reproduced in full colors in this superb volume, have preserved with wonderful fidelity not merely the richness of tint in plumage but the animation and the personality, so to speak, of each subject.

An engaging chapter is contributed by F. H. Kennard on "Encouraging Birds Around the Home." Mr. Kennard persuades the reader to become a conserver of bird life, whether he be the possessor of a great estate or the owner of a window-sill.

That mysterious impulse which Nature has implanted in so many of her creatures—the migrating instinct—is the subject of a wonderful chapter by Professor Wells W. Cooke.

George Shiras, 3rd, noted as a traveler and naturalist and as the inventor of a method whereby birds and wild animals make their own portraits, gives a delightful account of photographing wild birds with a flashlight camera.

The Book of Birds is a gift to delight the naturalist who can spend days in the forest, the business man who has only an occasional hour in the woods, or the man or woman whose sole acquaintance with birds is made in the city parks. Placed in the hand of a boy or girl, it will inculcate an imperishable love of Nature and Nature's winged children.

— — — — — — — — — — — — CUT ON THIS LINE — — — — — — — — — — — —

DEPT. H, NATIONAL GEOGRAPHIC SOCIETY, 16th and M Streets, Washington, D. C. 1918

Please send.....copies of "THE BOOK OF BIRDS," bound in.....
for which I enclose herewith.....dollars.

If several copies are desired, write names and addresses and send with your card.

Name.....

Street Address.....

City and State.....

Bound in Royal Buckram, postpaid in U. S., $3.00
Bound in Limp Khaki, postpaid, $3.00

5-18

This is not Switzerland but the Pacific Northwest

Oregon
Washington and
British Columbia

ON THE TOP OF THE WORLD

You should feel that way if in good health and fit to help win the war.

SPEND THIS SUMMER'S VACATION

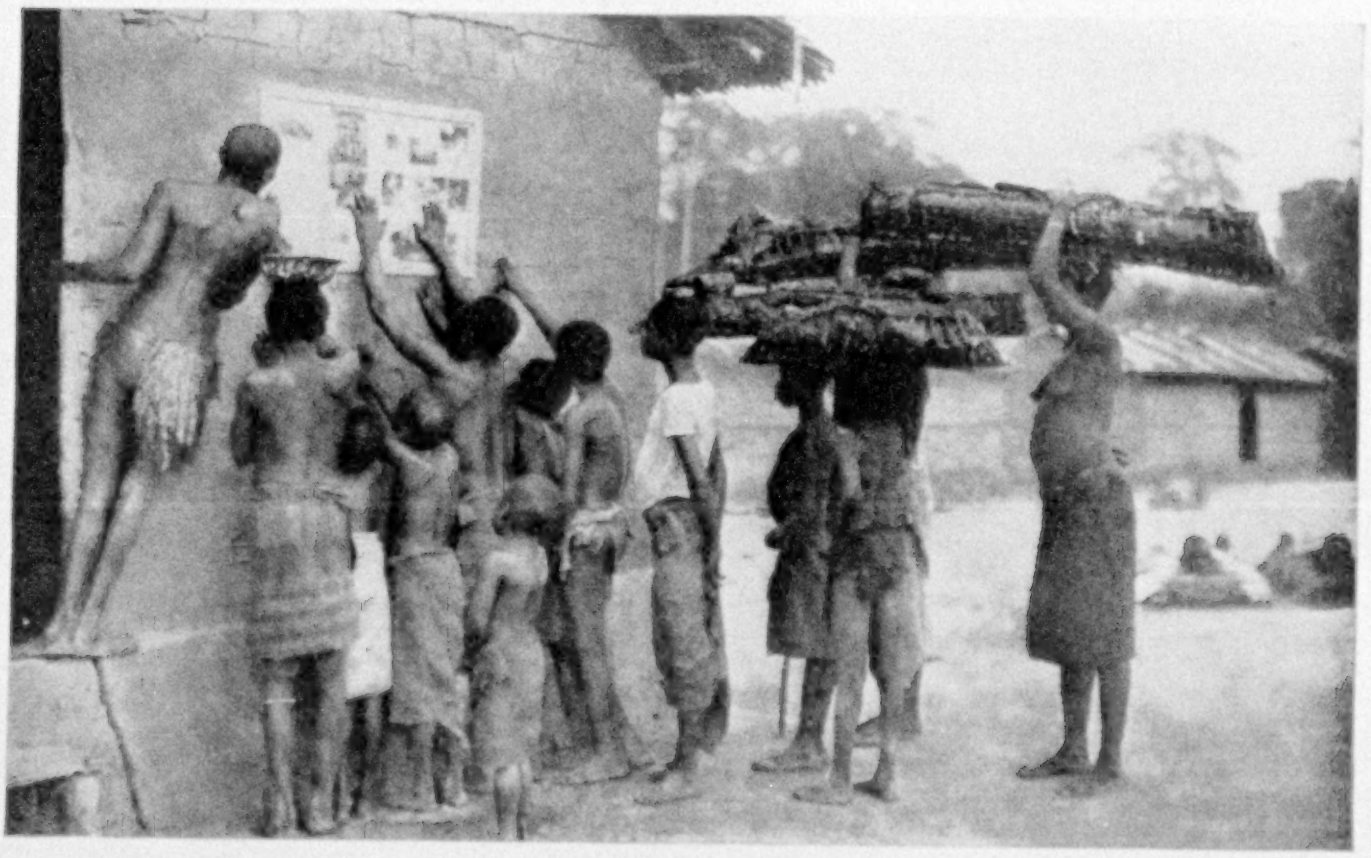
In the Pacific Northwest

Oregon, Washington and British Columbia

Climb these mountains, fish its streams and rivers, play golf on its forty Evergreen courses, sail on its 3,000 miles of inland seas, motor on its 15,000 miles of scenic highways; and learn something of the marvelous industrial and win-the-war activities.

In the World's Greatest Out-of-Doors

Write for free illustrated booklet to any Chamber of Commerce, Board of Trade or Commercial Club in the Pacific Northwest, or the Tourist Department, Parliament Buildings, Victoria, B. C.; Capitol Buildings, Salem, Oregon, or Olympia, Wash., or the office of the Executive Secretary, Herbert Cuthbert, Pacific Northwest Tourist Association,
1017-1018 L. C. Smith Building, Seattle, Wash.



NATIVES ATTRACTED BY A PICTURE POSTER: AFRICA
Living proof of that dominant human characteristic—the love of pictures.

NEW FOURTH SERIES

Scenes from Every Land

200 Full-page Illustrations, 24 Pages in Matchless Natural Colors
20,000 Words of Descriptive Text

By GILBERT GROSVENOR, Editor National Geographic Magazine

EXCELLING in beauty and in compelling interest its three predecessors, the fourth volume of the National Geographic Society's "Scenes" series may now be secured from the Washington headquarters of the Society. The first two series of "Scenes from Every Land" have been entirely exhausted and cannot be had at any price, while only a few copies remain of the third. To insure your copy of the NEW series you should order at once.

"Scenes from Every Land" is like no other book in the world. It occupies a unique place in the literature of the universal language—the language of pictures, through which man becomes acquainted with his fellow-man on the other side of the world. The Editor has selected 200 photographic gems from the Society's great treasure-house of pictures, which is being constantly enriched by contributions from explorers, scientists, world-travelers, artists, and lovers of nature in every quarter of the globe. These pictures tell their own story of strange peoples, odd customs, the history of ancient civilizations written in the massive ruins of their temples, palaces, and amphitheaters, the master achievements of modern engineers—the builders of canals, bridges, and cities—and the inspiring manifestations of the handiwork of Nature, wrought in mist-crowned mountains, shimmering waterfalls, and landscapes of magic beauty.

The Society is able to publish this volume, which includes 24 pages in full colors, at a nominal price, owing to the fact that most of the illustrations have appeared previously in the NATIONAL GEOGRAPHIC MAGAZINE and the expense of engraving both the color and the black-and-white plates has already been borne. No picture in the Fourth Series, however, is to be found in any of the earlier volumes.

——— CUT ON THIS LINE ———

DEPT. H, NATIONAL GEOGRAPHIC SOCIETY,
16th and M Streets, Washington, D. C. ....., 1918.

Please send.....copies of the **Fourth Series "Scenes from Every Land,"** bound in.....
for which I enclose herewith.....dollars.

If several copies are desired, write names and addresses and send with your card.

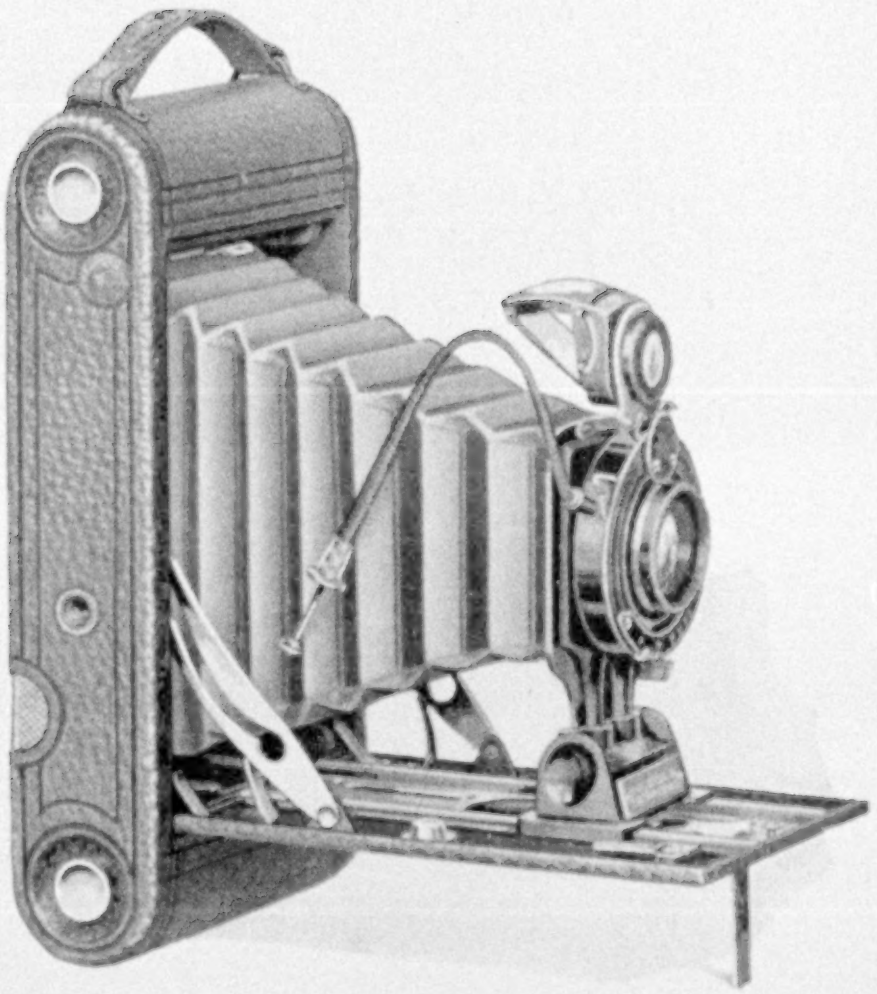
Name.....

Street Address.....

City and State.....

Bound in Royal Buckram, postpaid in U. S., $2.00
Bound in Full Leather, postpaid, $2.50 (De Luxe Edition)

5-18



Price
$15.50

Pictures
2⅞ x 4⅞

2c Kodak Jr.

The pictures are of the pleasing panel shape, giving the high, narrow proportions that are so well suited to portraits—and when the camera is held horizontally, for landscapes and the like, it gives a long, narrow picture that is almost panoramic in effect.

And this long, narrow picture makes possible a thin, slim camera that fits the pocket—a detail that is often important, and always convenient.

The 2c Jr. loads for 10 exposures, is fully equipped for hand or tripod work. For snap-shots the shutter has speeds of 1-25, 1-50 and 1-100 of a second, and it has, of course, the usual "time exposure" releases. Well made and well finished in every detail—autographic, of course. All folding Kodaks now provide for autographically dating and titling each negative at the time of exposure.

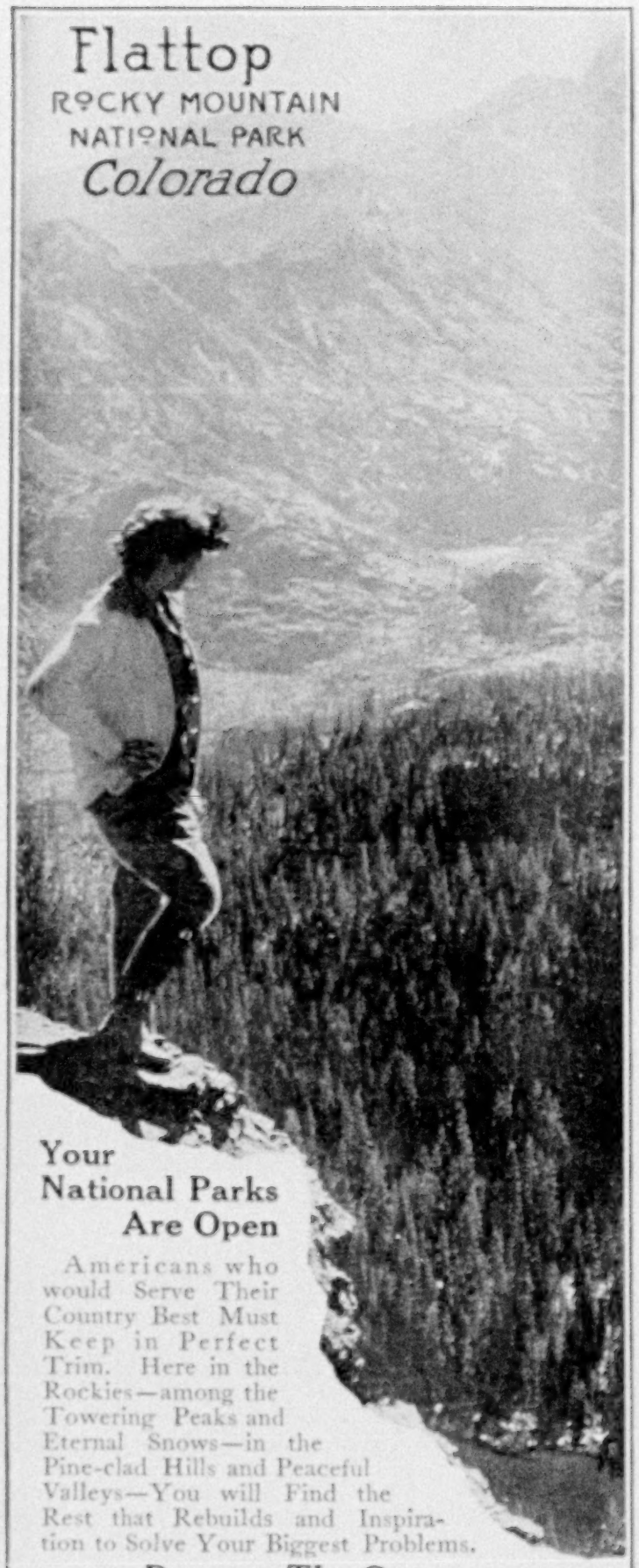
The lenses are the best of their respective types, are adapted to this particular camera and each one is *individually tested.*

THE PRICE

No. 2c Autographic Kodak, Jr. with meniscus achromatic lens	$15 50
Do., with Rapid Rectilinear lens	17 50
Do., with Kodak Anastigmat *f.*7.7 lens	23 50

At Your Dealer's

EASTMAN KODAK CO., ROCHESTER, N. Y., *The Kodak City.*



Your National Parks Are Open

Americans who would Serve Their Country Best Must Keep in Perfect Trim. Here in the Rockies—among the Towering Peaks and Eternal Snows—in the Pine-clad Hills and Peaceful Valleys—You will Find the Rest that Rebuilds and Inspiration to Solve Your Biggest Problems.

Denver, The Gateway
To 12 National Parks and 32 Monuments

Let us help you plan your Western trip—tell you where to go, what to see, how to get there, and what it costs. No charge for this service. Write for descriptive literature.

DENVER TOURIST BUREAU
614 Seventeenth Street, Denver, Colorado
Branches: Chicago • Kansas City • St. Louis • Colorado Springs

You Can Hear

As Well As This

Just Let Us Prove It!

All but a few of the many thousands hard of hearing who have responded to our advertising have at the time expressed serious doubt that they would ever hear clearly again—but the result of a free trial of the "ACOUSTICON" has been that 325,000 are now in the hands of delighted users.

That is the reason we are so persistent in repeating the suggestion that you just write us saying: "I am hard of hearing and will try the ACOUSTICON." We will immediately ship you the new

1918 Acousticon

FOR 10 DAYS' FREE TRIAL — DICTOGRAPH PRODUCT — NO DEPOSIT—NO EXPENSE

WARNING! There is no good reason why everyone should not make as liberal a trial offer as we do, so do not send money for any instrument for the deaf until you have tried it.

With its new diminutive ear-piece, smaller and better than ever, and its patented features which cannot be duplicated, no matter what you may have tried in the past, we suggest that you convince yourself as to this new 1918 "ACOUSTICON" by asking for your free trial today—you alone to decide. Address

GENERAL ACOUSTIC CO., 1311 Candler Bldg., NEW YORK
Canadian Address, 621 New Birks Bldg., Montreal

Blake School for Boys

LAKEWOOD, NEW JERSEY

Summer Session (June--October)

A small home school where your son will receive the maximum of individual instruction. Wonderful climate for growing boy. Military Training, Horseback Riding, Land and Water Sports, with Careful, Competent Instructors. *Our new booklet mailed upon request. Address Secretary, Blake School for Boys, Lakewood, N. J.*

Lantern Slides from Photographs in National Geographic Magazine

So many requests are being constantly received regarding lantern slides from the copyright photographs in the Geographic that arrangements have been completed to supply them to members of the Society. Slides are not kept in stock, each order being made up as received, and will be delivered within two weeks after receipt of order, unless otherwise advised.

The copyright notice must appear on each slide. The purchase of lantern slides does not carry with it the authority to publish the pictures and they cannot be used for advertising purposes.

Slides cannot be sent upon approval and a remittance must accompany each order. The slides will be carefully packed and sent by express collect. Prices in the United States (standard size), black and white, 75 cents each; colored, $1.50. Address,

DEPT. L,
NATIONAL GEOGRAPHIC MAGAZINE
WASHINGTON, D. C.

Descriptive Text by Edward W. Nelson, America's Foremost Authority on Animals

127 Paintings of the Mammals of North America in Full Colors by Louis Agassiz Fuertes

50 Reproductions of Animal Tracks Drawn by Ernest Thompson Seton

A Series of Drawings of American Prehistoric Mammals by Charles R. Knight

32 Black and White Pictures from Unusual Photographs of American Wild Life

INTRODUCING A LITTLE BLACK BEAR TO A LITTLE BROWN BEAR AT SEWARD, ALASKA

Wild Animals of North America

Intimate Studies of the Big and Little Citizens of the Animal Kingdom

THERE is no subject richer in fascinating interest than the study of animal life. To see all the types and representative species in their native environment, to watch them meeting their respective problems of life and adapting themselves to the conditions they have to face, and to follow nature through its many moods as typified by its wonderful variety of mammalian forms is a delightful and informative diversion.

To do this under the guidance of one of those born observers, whose eyes are always open, whose ears are always keen, whose brain is always quick to grasp, and whose pen is ever facile, is to become intimately acquainted with one of the richest chapters in zoology.

Such is to be the good fortune of those who receive a copy of the National Geographic Society's new Book of Mammals. This work is the consolidation of Mr. Nelson's splendid nature articles in the GEOGRAPHIC.

There is no man so well fitted to introduce you to the mammals of North America as Mr. Nelson, the Chief of our remarkable U. S. Biological Survey. For forty years he has been their friend, living among them and studying their habits and traits in the most intimate way. To him an animal is something more than flesh and bone and skin and fur. It has a personality; and he is as careful to record this as to describe the formal qualities which science writes down in species descriptions.

Mr. Nelson is a naturalist of the John Burroughs order. To visit the people of woodland, mountain, and field with him is to discover a new world.

Illuminating Mr. Nelson's descriptions are natural-color illustrations from the brush of that gifted artist-naturalist, Louis Agassiz Fuertes. Mr. Fuertes is not only a master of color but also of pose, and he can catch the timid alertness of the prong-horn antelope, the cruel sagacity of the arctic wolf, the lazy indifference of the common skunk, or the wide-awake watchfulness of the gray squirrel, with equal facility.

Added to these is a series of 50 drawings by Ernest Thompson Seton, depicting the footprints of various animals as they appear in the light snow of field or forest or in the dust of the wayside. These will enable the reader to identify the tracks of many of the mammals of North America.

Together these authorities have produced a book that is without counterpart in the literature of animal life. Wild Animals of North America will be ready about **August 1.**

CUT ON THIS LINE

DEPT. H, NATIONAL GEOGRAPHIC SOCIETY, ..., 1918
16th and M Streets, Washington, D. C.

Please send.....copies of "WILD ANIMALS OF NORTH AMERICA," bound in.....
for which I enclose herewith.....dollars.

If several copies are desired, write names and addresses and send with your card.

Bound in Royal Buckram or Limp Khaki, postpaid in U. S., $3.00

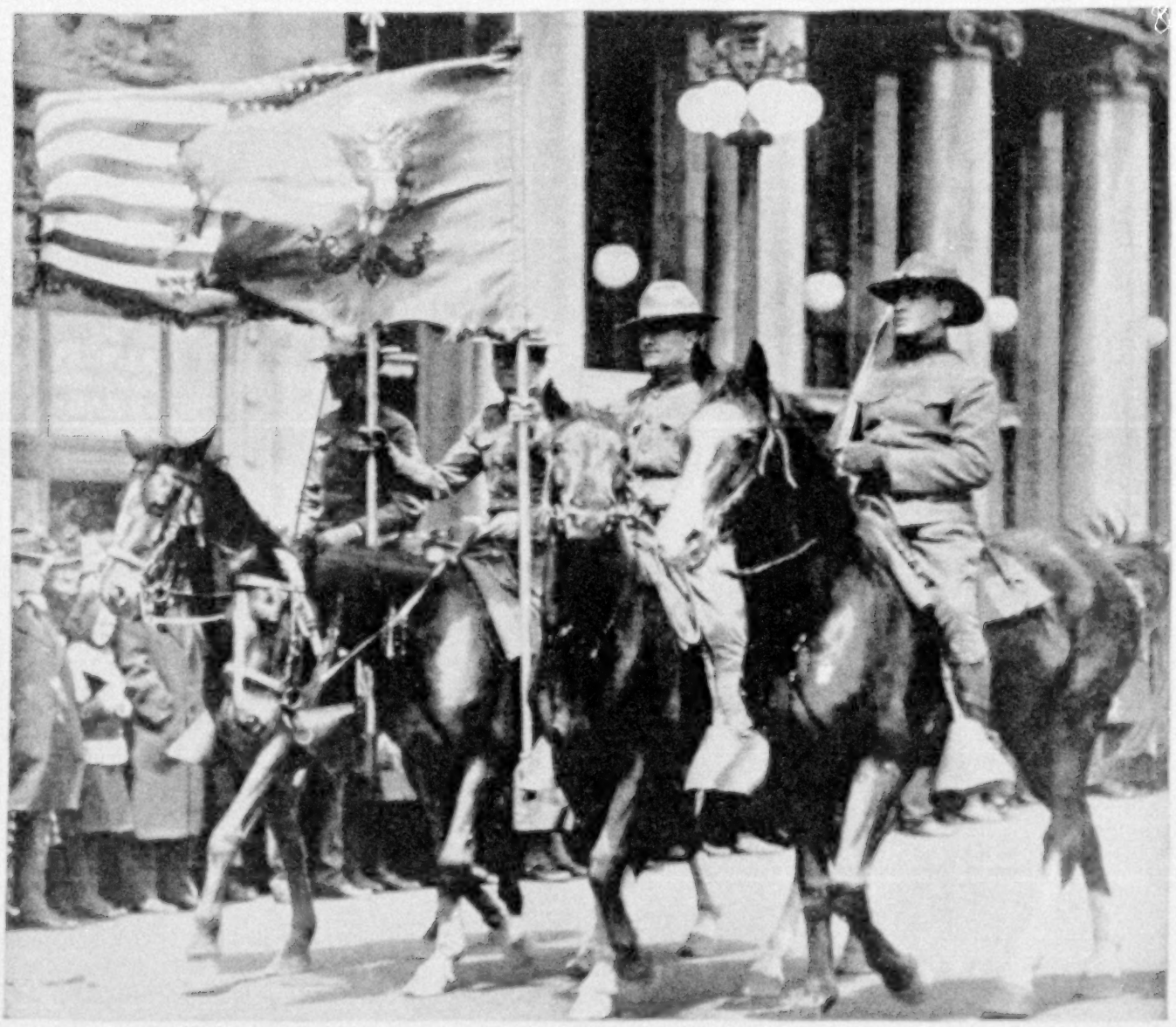
Name.....

Street Address.....

City and State.....

5-18

XUM



A POST OF HONOR: THE GUARD TO THE REGIMENT'S STANDARD

Flags of the World

By Lieutenant-Commander BYRON McCANDLESS and GILBERT GROSVENOR

A HANDSOMELY BOUND VOLUME of 150 pages, containing 1,200 flags in their full colors, 300 illustrations in black and white, the complete insignia of the uniformed forces of the United States, the international flags in use on land and sea, together with an epitomized history of each flag, and an authoritative history of the "Star Spangled Banner." In this book there are published for the first time the flags of each of the forty-eight United States in full colors and with complete descriptions based on original research and approved by the State officials.

The Federal Government put all of its resources at the command of the National Geographic Society in order to insure the correct reproduction of every military and naval flag in its proper design and coloring. The same coöperation was given by the Embassies and Legations of all the friendly countries represented. No complete collection of Pan American flags hitherto published has been correct, and the same is true of Asiatic flags.

This flag book is as authoritative as an official report, as delightful as fine fiction, and as beautifully illustrated as a gem of the printing art can be. Bound in stiff royal buckram, it is being placed in thousands of home libraries and is a gift par excellence.

Our military and naval forces find "Flags of the World" extremely useful, containing, as it does, the most complete and recent information on the important subject of flags and signals. Every soldier and sailor is glad to have one of these books, and to make them most suitable for this purpose a special edition has been printed on water-proof paper and bound in a LIMP KHAKI cover, which will stand the wear and tear of every-day use in the field or on board ship. This is a gift your boy in his country's service will appreciate.

CUT ON THIS LINE

Dept. H, National Geographic Society,
16th and M Streets, Washington, D. C. _____ 1918

Please send _____ copies of "FLAGS OF THE WORLD," bound in _____

for which I enclose herewith _____ dollars.

If several copies are desired, write names and addresses and send with your card.

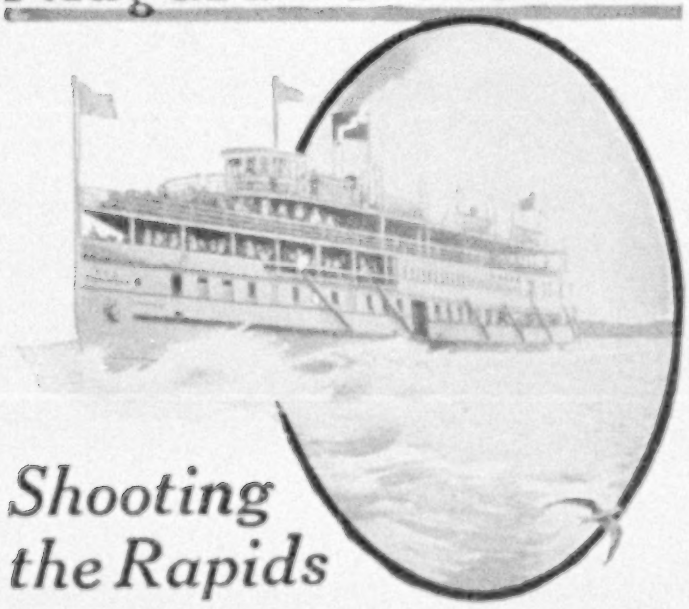
Name _____

Street Address _____

City and State _____

Bound in Royal Buckram, postpaid, $2.00
Bound in Limp Khaki, postpaid, $2.00 5-18

Niagara to the Sea



Shooting the Rapids

THE most satisfying trip in America for health and recreation. Almost 1000 miles of lakes, rivers, and rapids, including the Thousand Islands, the exciting descent of the marvelous rapids, the historic associations of Montreal, quaint old Quebec, with its famous miracle-working shrine of Ste. Anne de Beaupre, and the renowned Saguenay River with its stupendous Capes, "Trinity" and "Eternity," higher than Gibraltar.

Complete Standard Service maintained.

Send 2c postage for illustrated booklet, map and guide, to John F. Pierce, Assistant Traffic Manager, Canada Steamship Lines, 107 C. S. L. Building, Montreal, Canada.

Canada Steamship Lines

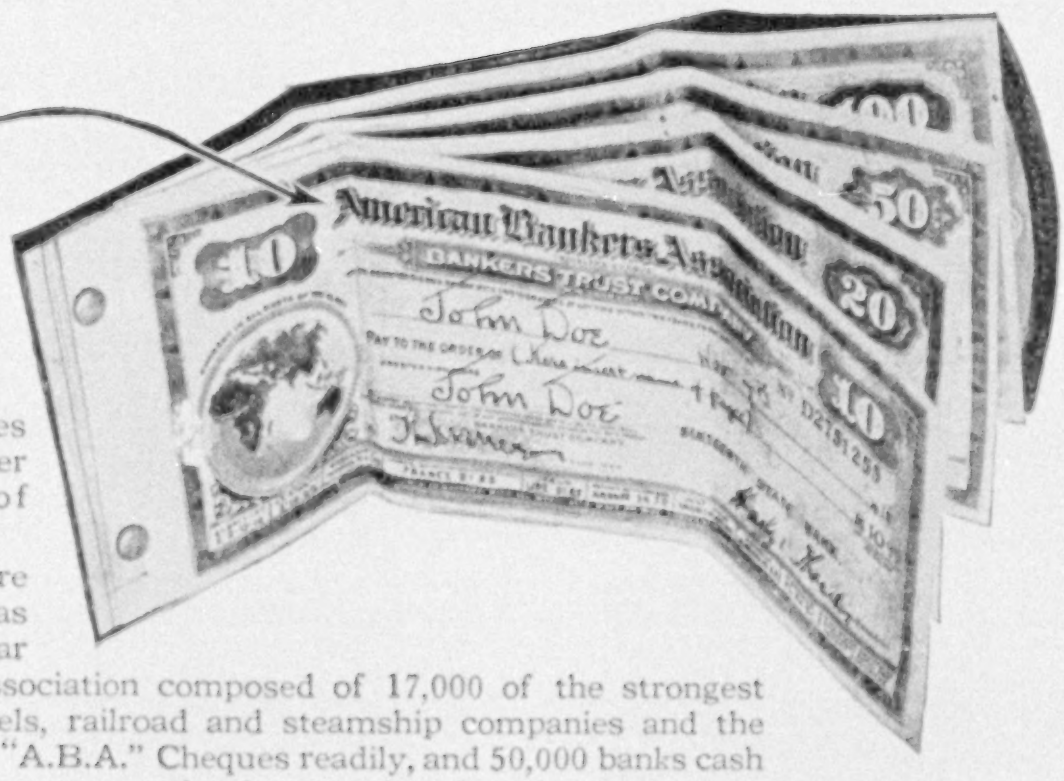
DENBY
MOTOR TRUCKS

DENBY originated many features of motor-truck design which Denby performance has since made standard.

Denby Motor Truck Company

Detroit, Michigan

This name American Bankers Association



makes "A.B.A." Cheques recognized the world over as the safest form of "travel money."

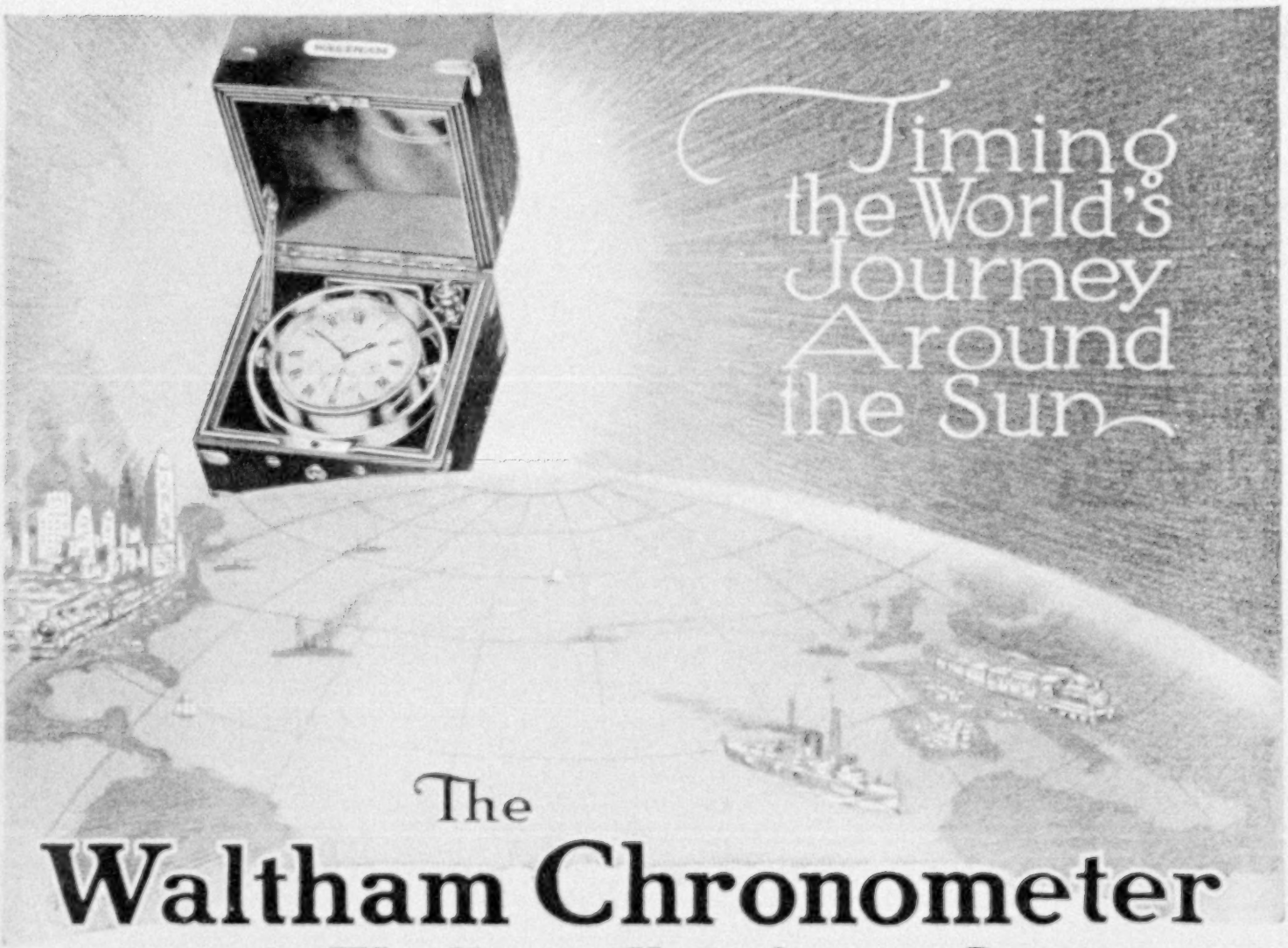
They are everywhere known to be as good as gold, because they bear the approval of an Association composed of 17,000 of the strongest American banks. Hotels, railroad and steamship companies and the best merchants accept "A.B.A." Cheques readily, and 50,000 banks cash them. Ideal funds for persons going into service abroad.

The only identification needed is the countersignature of the owner *in the presence* of the person accepting an "A.B.A." Cheque.

Get them at your bank, or write Bankers Trust Company, New York, for booklet and information as to where they may be obtained in your vicinity.

"A.B.A." American Bankers Association Cheques

"Mention the Geographic—It identifies you."



The

Waltham Chronometer

Times the War Ships of Uncle Sam and Britain

Dreadnoughts of war guarding the gateways of nations; destroyers vigilantly roaming the seas in quest of their hidden prey; ocean leviathans that carry their passengers safely from shore to shore when peace reigns — these are guided in their activities by Waltham Chronometers.

No greater faith was ever shown in the precision of a timepiece than when the war governments of the United States, England and Canada placed their orders at Waltham. Faith based on tests which proved the reliability and precision of the Waltham Chronometer.

Waltham, the only watch factory in the world equipped to make Chronometers, is also supplying other timepieces for war work. Deck clocks, comparing watches, airplane clocks, wrist watches, all made at Waltham, are doing their bit in helping the Allies go "over the top" to victory.

Visit the jeweler whose reputation stands highest for quality. Ask him to show you some of the Waltham models—for example, the Riverside. Here is a watch you will be proud to give or to own. Moderate in price, and made in five sizes—three for men and two for women.

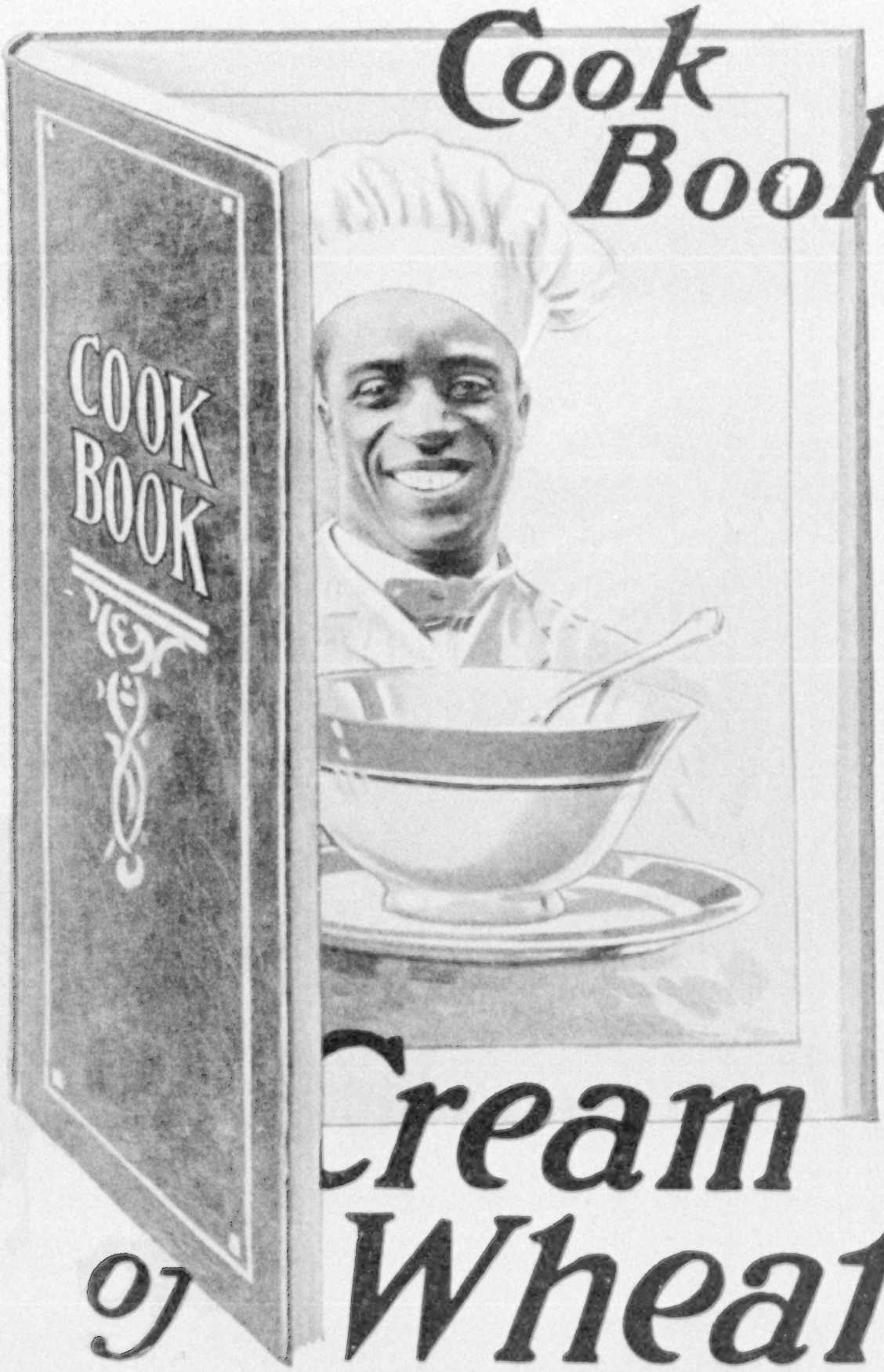
The Riverside symbolizes that lofty ideal of fine watchmaking which has led the horological experts of the greatest nations to choose Waltham in preference to any other watch made in America—in preference also to the finest timepieces of Switzerland, England or France.

WALTHAM

THE WORLD'S WATCH OVER TIME

"Mention the Geographic—It identifies you."

The Best Dish in the Cook Book of Cream of Wheat



Copyright 1907 by Cream of Wheat Co.

PRESS OF JUDD & DETWEILER, INC.
WASHINGTON, D. C.

COLGATE'S "HANDY GRIP"

Patented 1917

The Thrifty Shaving Stick

When you buy a shaving stick see how much *soap* you are getting, and whether you can use *all* of it.

The most economical form of shaving soap is the stick—we make Shaving Stick, Powder, and Cream, so we are in a position to give this disinterested advice.

The "Handy Grip" is the thrifty stick that gives a plentiful, softening lather, using up but little soap. No waste in Colgate's—you can *unscrew* the last half inch and stick it on a new stick, as illustrated.

Colgate & Co. **New York**

Unscrew the stub

Stick it on a new stick